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History of White Pine Blister Rust Control—A Personal Account

HISTORY OF WHITE PINE BLISTER RUST CONTROL— A PERSONAL ACCOUNT

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Foreword

With much personal satisfaction I write this introduction to Warren Benedict's story of white pine blister rust control. I first came in contact with this work in the 1930's. Whenever I visited Blister Rust Control (BRC) camps I always came away with the feeling that these young men were helping to save a valuable natural resource and that in the process they were learning much about forest conservation. Moreover, thousands and thousands of young people were having this useful experience.

Several years ago I repeatedly urged that someone write the history of the Blister Rust Control Program. Obviously, if a history of this kind were done, it should be done by someone who has had actual experience in the program. If some future historian without such experience should attempt to write the story merely by compiling scattered statistics, it would be not only a dry as dust account but the statistics might not be fully understood. Nearly all the former top administrators of the BRC program are gone. As one of the very few top BRC people still alive, we thought that Benedict's nearly half a century of intimate knowledge of this program should be utilized before it was too late. So we asked "Blister Rust Bennie" if he would collect the facts and write the BRC history. This report is the result of that request.

Benedict's story of the widespread efforts to control this pernicious tree disease is interesting, convincing, and accurate because it was written from firsthand knowledge. It is a significant contribution to the history of resource conservation.

RICHARD E. MCARDLE
Former Chief, Forest Service

The fight against blister rust was the first large-scale nationwide attempt to contain a forest disease, and it dramatized that forest protection meant more than just fighting fire. This history should provide some lessons to forest ecologists today who must choose among various means of environmental manipulation with limited funds, as did the Blister Rust Control Program.

The Forest Insect and Disease Management Staff and the History Section, Administrative Management Staff, Forest Service, cooperated in the preparation and publication of this informal but informative history of the White Pine Blister Rust Control Program.

Preface

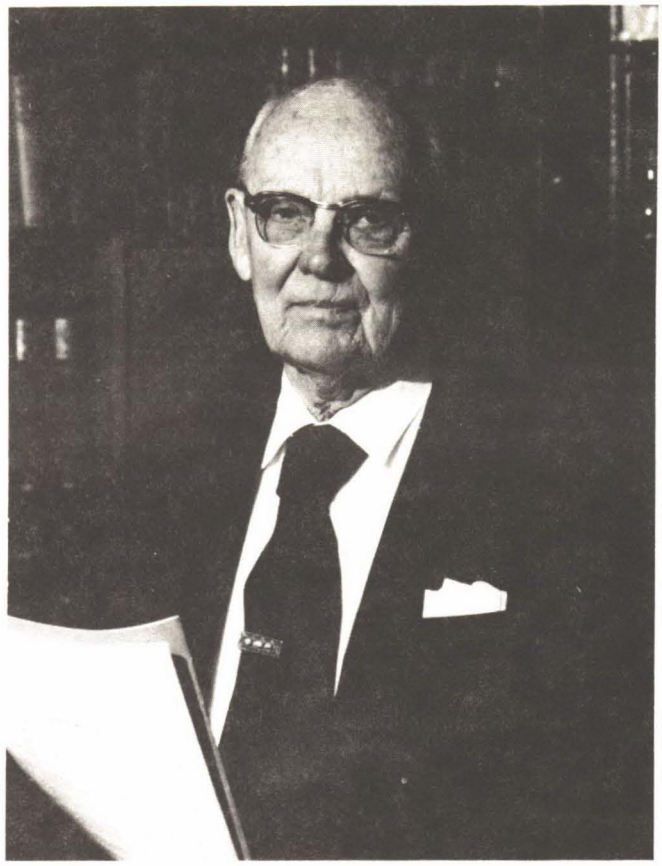
I expect more material has been written about blister rust than any other tree disease in America. A comprehensive bibliography on blister rust assembled by Roy Hoff of the Forest Service Genetics Laboratory at Moscow, Idaho, contains 2,228 entries. In addition, six file cases of material, including mostly internal records and correspondence, were stored in the Federal Records Center, Suitland, Md. To have examined all this material, even superficially, would have taken a big cut from my remaining lifetime. But to do so was hardly necessary since I spent more than 42 years working on blister rust in one capacity or another and helped establish the western control program. Consequently, I became acquainted with the leaders of the blister rust program including personnel of the Forest Service, the National Park Service, the Bureau of Land Management, the Bureau of Indian Affairs, State agencies, conservation groups, and timber companies. As a result, I have drawn upon my own background and experiences to put together a large part of this story. The material I reviewed, both published and unpublished, is listed in appendix I.

In addition, I had the pleasure of visiting all the white pine regions to interview many oldtimers. They have provided much helpful information on how blister rust control work was accomplished in their respective regions, areas, States, and districts. Their detailed descriptions have proved to be a valuable source of information.

In all, I interviewed 35 former "blister rusters." A complete list of their names appears in appendix II. While it is impossible to comment upon them individually, I do extend a hearty thanks to each one for his cooperation. To the following 10, I extend special thanks for arranging numerous interviews and for narrating the highlights of their associations with the BRC program: Edmund Filler, Northeastern BRC Region; Henry N. Putnam, Northcentral BRC Region; J. Curtis Ball, Southern Appalachian BRC Region; Roy Blomstrom, Thomas H. Harris, Douglas R. Miller, and Harold R. Offord, Pacific Coast BRC Region; Homer J. Hartman, Richard T. Bingham, Virgil D. Moss, and Charles A. Wellner, Inland Empire area; Conrad P. Wessela, Pacific Coast Region (and member of my staff in the Washington office), and Gilbert B. Posey, Washington, D.C., who was the last living member of the original Office of Blister Rust Control staff in Washington, D.C. (Posey died just before this manuscript went to press.)

In developing this historical narrative, it was not my intent to adhere to a fully documented scientific style. Rather, I have told the story in an informal way. My narrative recounts the unfolding of events as I know them—the good and bad, the successes and failures. Many mistakes were made in the course of the fight to save America's white pines from blister rust. And while these mistakes were nearly always errors of human judgment, the best judgment based on knowledge available at the time was always applied. The point is that no more dedicated group of public servants ever worked together under strong, aggressive, honest leadership than the BRC bunch, and I am proud to have been a member of that team. This is our story.

Washington, D.C. WARREN V. BENEDICT



Warren V. Benedict

Warren V. Benedict spent his entire career in the white pine blister rust control program and other forest pest control work. He was appointed a temporary agent for the old USDA Bureau of Plant Industry in Portland, Oreg., in June 1924. He retired as chief of all pest control work of the Forest Service, including its cooperative programs with the States and private owners, at the end of 1966.

His interest in forestry stemmed from a boyhood spent exploring the near wilderness surrounding the lumbering town of Hoquiam along the coast of western Washington just after the turn of the century. As he grew up he saw groves of giant trees change to acres of stumps and he wanted to play some part in improving forest management. Rather than obey the wishes of his father to become a physician, he went to Oregon Agricultural College (now Oregon State University) at Corvallis where he received his B.S. in Forestry in 1924.

Benedict first worked on blister rust in northern Idaho, then became leader of the program in the sugar pine forests of Oregon and California in 1927. In 1951 he became director of the western region of USDA's Bureau of Entomology and Plant Quarantine, and in 1953 when all Federal and Federal-State forest pest control was shifted to the Forest Service he headed that work in Washington, D.C. The next year other tree diseases and insects on all forest land were added to his duties.

Benedict married Trula Miller, also a 1924 OAC graduate, after his first 6-month appointment. They have three sons and a daughter, all married, and 12 grandchildren. They live at Glen Mar Park, Md., just outside Washington, D.C.

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BLISTER RUST AND THE PROGRAM TO CONTROL IT, 1909–41

The Problem

This story has its beginning in Geneva in central New York State in 1909 when blister rust was discovered in a plantation of young white pines grown from planting stock imported from Europe. Clifford R. Pettis, who had graduated in 1902 in the first class from Cornell University's new Forest School, found the infection. He was beginning a long career as forest nurseryman and conservationist with the New York State Conservation Commission.

Since he had a special interest in white pine trees, Pettis always observed them closely. While examining a plantation of young eastern white pines recently transplanted from German nursery stock, he noted an abnormality on two trees. Yellowish, elongated swellings were appearing along some of the branches. He had no idea what this disease might be, but was worried enough to send a telegram to Dr. Haven Metcalf of the Office of Forest Pathology in the Bureau of Plant Industry of the U.S. Department of Agriculture (USDA) in Washington, D.C. Pettis described the swellings and suggested a pathologist be sent to make an identification. Dr. Perley Spaulding of Metcalf's staff suspected the worst. Metcalf sent him at once to Geneva, where his suspicions were confirmed at a glance. The disease was indeed the dreaded blister rust of white pine! While there had been several earlier findings—including even some diseased currant bushes near a Geneva nursery in 1906, and a few scattered sightings dating back to 1898—it was the 1909 discovery that flashed the red light of Danger Ahead!

The Disease

White pine blister rust is known as a heteroecious rust fungus—a parasitic fungus that requires two distinctly different and often unrelated species or genera of alternate host plants to complete its life cycle. Known botanically as *Cronartium ribicola,* blister rust has as its primary host the white pines. It does not attack the other (hard) pines. Seven species of white pine are native to North America, and three of these have great commercial value, eastern and western white pine, and sugar pine. The secondary host for blister rust can be either currant or gooseberry bushes, which are known collectively by botanists as *Ribes* after the genus or plant family to which they belong. In America, 65 species of *Ribes* are present, both cultivated and wild.

Blister rust is relatively harmless to currant and gooseberry bushes, but can kill white pine trees of all sizes. Small trees succumb fairly soon after becoming infected; larger ones die more slowly. The life cycle of this fungus has three major phases that show up alternately as a growth on white pines, then on *Ribes,* then from *Ribes* to *Ribes,* then on white pines again. Blister rust is not directly communicable between pines. It must alternate between pines and *Ribes.* There is an intermediate stage in which the disease is spread by urediniospores among *Ribes* bushes before returning to pines.

The spread of the disease from pines to *Ribes* is caused by small, tough, pollenlike spores (aeciospores) that can be blown long distances by the wind. In contrast, the pine-infecting spores (sporidia) produced on *Ribes* are relatively

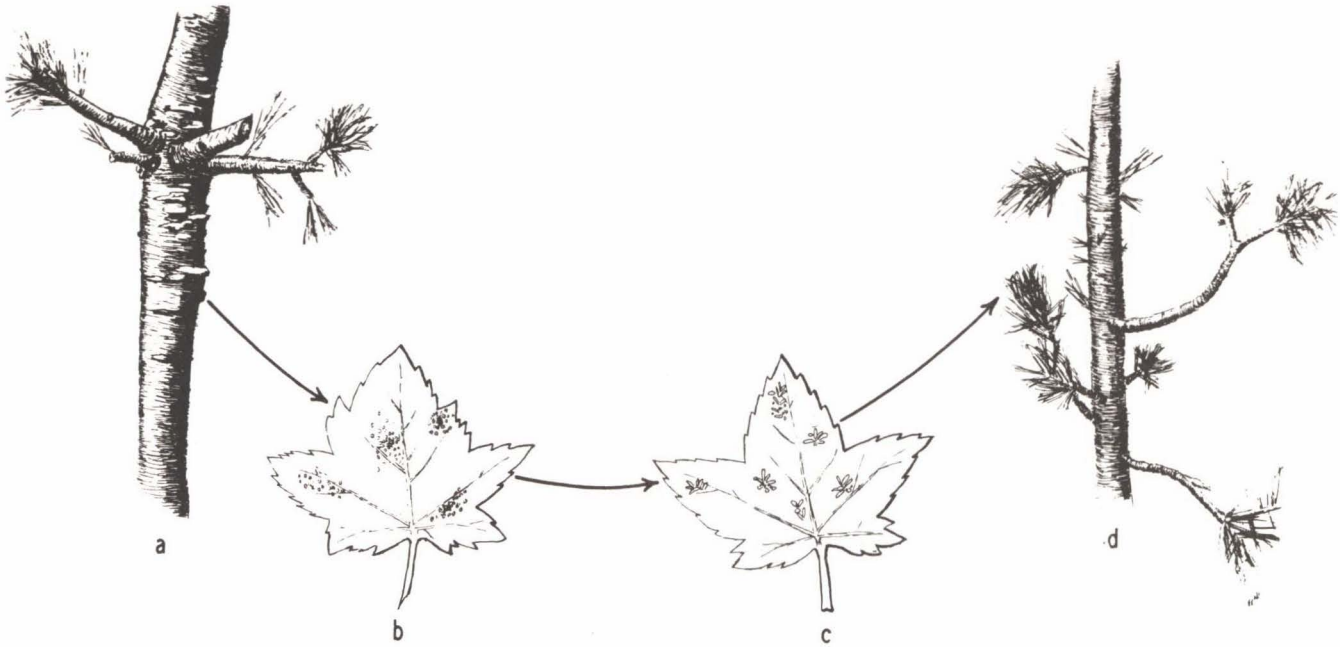

Figure 1.—Sketch shows chain of infection of the blister rust fungus, by spores from white pine bark cankers to *Ribes* leaves and back to another white pine. The successive stages are: (a) Blisters on pine bark break open and release clouds of yellow spores which are carried by winds to *Ribes* leaves (b), where they germinate and grow in patches to produce another type of spore which infects other *Ribes* in the vicinity (c), where still another type of spore is produced which then is carried by winds to infect the needles of other white pine trees (d), from which the infection spreads down into the bark.

(Sketch by USDA Bureau of Entomology and Plant Quarantine)

heavy and quite fragile. These spores usually do not remain viable long enough to transmit infection to pines more than a few hundred yards away. The distance spores travel depends on the species and abundance of *Ribes* as well as local weather, wind, and topography. Herein lies the weak link in the life cycle of blister rust and the element that makes control possible. By removing the *Ribes* from within and for several hundred yards around white pine stands, the stands can usually be completely protected.

Blister rust infections on *Ribes* occur only on the living leaves and die when the leaves are shed in the fall. Only rarely does infection overwinter on *Ribes*. So blister rust is essentially a one-season disease on *Ribes,* and reinfection must occur each year while those bushes are in leaf. Frequently a *Ribes* may be infected one year, then escape infection for several years, depending upon the prevailing weather and the abundance of spores produced on nearby pines.

In contrast, pines become infected through their needles, and the disease spreads within the tissues of the tree until the infected twig or branch is killed, the branch dies naturally, or the infection girdles the tree. Thus, blister rust is an annual infection in *Ribes* bushes and a perennial disease in pine trees.

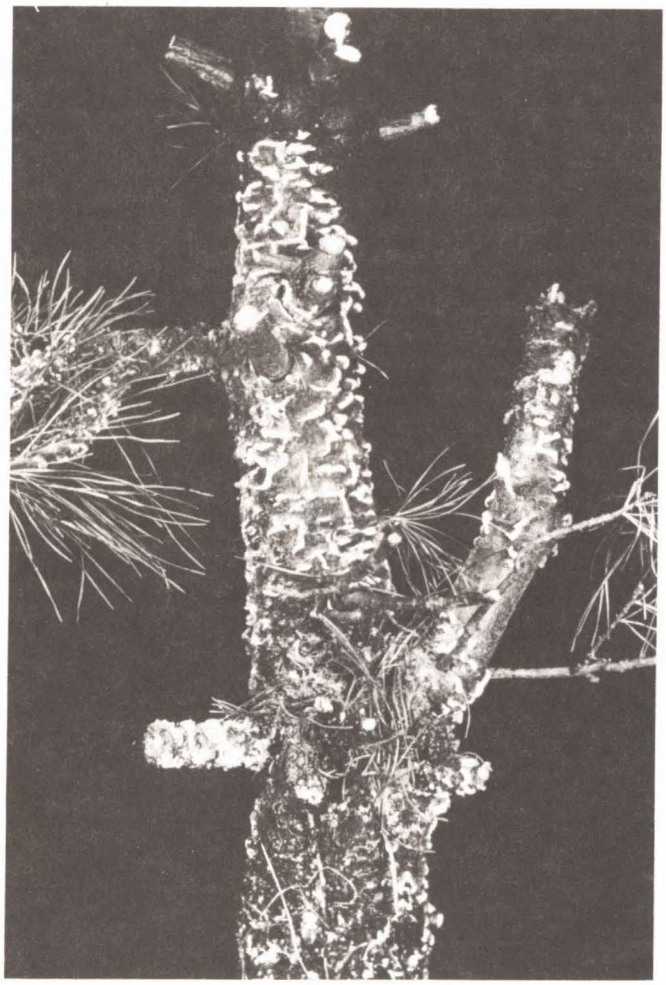

Figure 2.—Closeup of blister rust fungus infection on branch of young eastern white pine tree*(Pinus strobus);* bark is disfigured with numerous small ruptured swellings (cankers) bursting with yellow aeciospores which are carried by winds to *Ribes* leaves.

(Forest Service photo, F 520760)

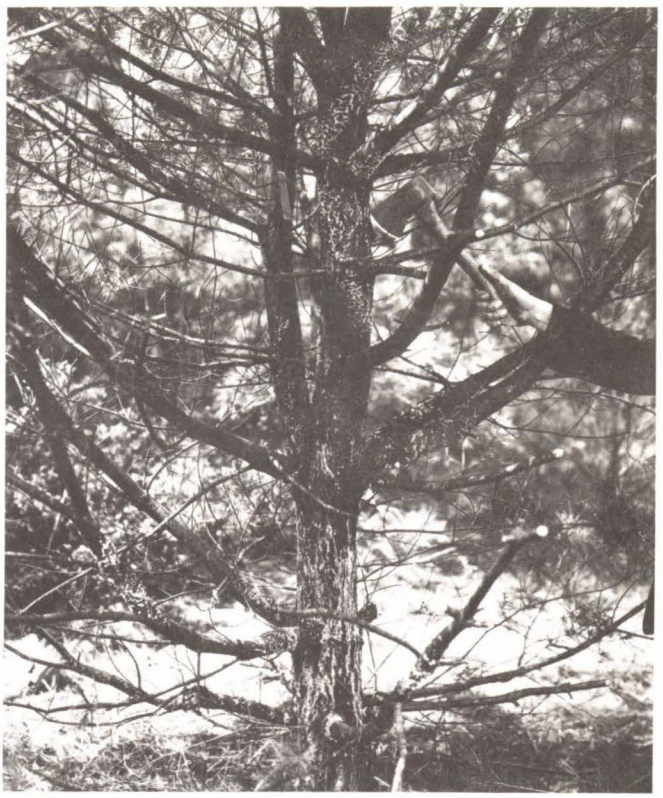

Figure 3.— Young eastern white pine tree heavily infested with blister rust. Note cankers on trunk and most branches, and dried rivulets of sap at base. Photo was taken in New England during early period of control campaign.

(Photo by USDA Bureau of Entomology and Plant Quarantine)

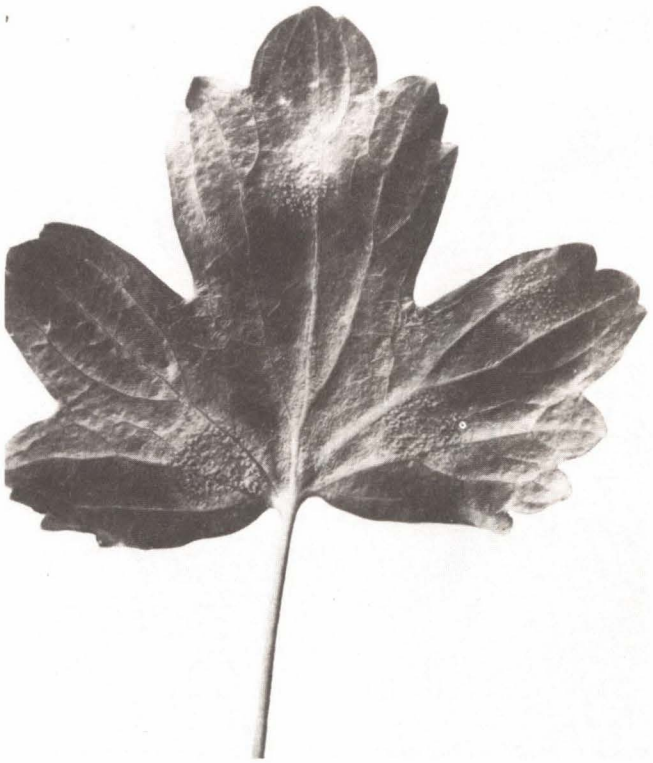

Figure 4.— Blister rust infection on *Ribes* leaf. This is the summer or uredial stage, where spores are produced that infect other *Ribes.*

(Forest Service photo, R-487421)

Since many pests in our forests nick away at the trees and even kill a few or occasionally many, why did one more disease become a cause for national alarm? The reason is that blister rust is not native to America. Native diseases are usually held in check by the development, over time, of various natural controls including effective resistance by the trees subject to attack. However, foreign diseases often pose a greater threat because native trees usually have no resistance to them and there may be no other natural controls. In several instances catastrophic damage to agricultural crops, trees, and even humans has been caused by introduced pests. For example, the chestnut blight caused by *Endothia parasitica,* imported from the Orient late in the 19th Century, so ravaged the valuable American chestnut that it disappeared from the hardwood forests of America within a few decades.

Blister Rust in Europe

Blister rust originated in northern Asia where it infected *Pinus cembra,* a native white pine, but caused little damage. The disease gradually spread into Europe from Siberia, across the Ural Mountains. Europe has no commercially important native white pines, and only one important pine species in the north: *Pinus sylvestris* or Scots pine. Yet European foresters had long appreciated the value of the eastern white pine of America, *Pinus strobus,* both for wood products and as an ornamental. About 1900, they began to import white pine seed from American sources to provide stock for commercial plantations. Eastern white pine (known as Weymouth pine in Europe after an Englishman, Lord Weymouth, who introduced it to Great Britain) was planted extensively across Europe.

While few wild *Ribes* exist in Europe, currants and gooseberries are widely cultivated. The most common *Ribes* is the European black currant or *Ribes nigrum.* American pathologists estimated that in the early 1900's more than 95 percent of all European rural families grew cultivated *Ribes,* mostly black currants. Unfortunately the cultivated black currant is the most susceptible of all *Ribes* to blister rust. It produces a virulent spore capable of infecting pine trees at greater distances and in greater numbers than spores produced on any other species of *Ribes.* Since black currants were so plentiful and grew in a climate favorable to the spread and development of blister rust, the growing of eastern American white pine was never able to fulfill the high hopes of European foresters. The disease destroyed the five-needle white pine plantations in Europe.

Blister Rust Comes to America

People in America were beginning to realize that their vast forests of eastern white pine were not as inexhaustible as they had once believed. Most forests in the northeastern and north-central United States had been cut over, and the need for extensive reforestation was becoming more and more pressing. In time, the demand for planting stock exceeded the capabilities of American nurseries, and attention turned toward possible foreign sources. Since nurseries in Germany, France, and Holland were producing vast quantities of planting stock at prices substantially below those of American nurseries, American nurserymen naturally turned to them for supplies. By the spring of 1909, millions of pine seedlings were being imported from Europe. Blister rust was already rampant there, and it was inevitable that rust-infected stock would eventually be shipped to America. The spread of blister rust to America was therefore an indirect consequence of the rapid disappearance of much of America's forest resources in the 18th and 19th centuries.

As early as 1898, Dr. Carl A. Schenck, a German forester demonstrating German forestry practices in the United States, warned against importing white pine nursery stock from Germany because of the great danger of introducing blister rust. He predicted disaster for America's white pines if the rust ever became established. His warning went unheeded. How much infected stock eventually arrived in America no one knows. And there was no way to tell how many imported trees were carrying blister rust since the disease has a 2- to 3-year incubation period during which no visual evidence of the disease is present.

European pathologists and foresters had long known about blister rust and how to control it, but there were no important commercial stands of white pine in Europe that required protection—only scattered plantations and ornamentals. On the other hand, cultivated *Ribes*—especially the black currant—was an important crop. So control was really out of the question. In Europe the white pine was sacrificed to retain the *Ribes.* This resulted in exporting the disease along with the infected trees to other countries, since no laws prohibited such trade.

In America, the situation was just the reverse. *Ribes* plants were plentiful, but mostly wild, and of little or no importance. The vast forests of white pine in both the East and West, however, provided the basis for a thriving timber industry. The choice confronting American authorities when the first infected pine was discovered in Geneva, N.Y., in 1909 was clear: Either remove *Ribes* in and near white pine stands while the disease was just becoming established or face the ultimate loss of much white pine.

So discovery of a few small pine trees infected with blister rust was to trigger a gigantic fight to protect the white pines of America, a fight that has been waged coast to coast for 70 years. It has affected the lives of thousands and the economic development of countless communities. And it was successful in many places, but in some it was a failure.

Perhaps the most important and lasting contribution to American forestry to grow out of the battle to save the white pine was the Blister Rust Control (BRC) Program. The program served as a model of how to gain large-scale control of a forest disease, and led to deeper appreciation by foresters, conservationists, and timberland owners of the essential role that forest pest control plays in the protection and management of forest land. As a cooperative program involving numerous organizations, groups, political units, associations, and individuals, the BRC Program was successful in creating good will and stimulating selective effort. Even today, those in outside organizations who became involved with the program speak well of it—its organization and operation, its accomplishments, and its leadership over the years. Many give the program credit for saving the eastern white pine from what could have been another disaster like chestnut blight.

A Solution

The Blister Rust Situation, 1909–16

A period of uncertainty in dealing with the problem followed the discovery of blister rust on pine here in 1909. It was a time for study, review, and ultimately decision on what could and should be done. To be sure, the disease had but a toehold. Perhaps it could be stamped out, but fast action was needed. American officials began to plan how to meet this potentially devastating situation.

The focal point for action was the USDA Office of Forest Pathology. In 1909 no comparable offices existed at either the State or local level. Dr. Haven Metcalf, a pathologist, was in charge. One of his principal assistants was Samuel B. Detwiler, a graduate forester from Pennsylvania Agricultural College who had worked for the USDA Forest Service and had taken part in the hopeless battle to save the blight-ridden American chestnut from another foreign pest. Metcalf assigned major responsibility for the blister rust problem to Detwiler.

Both men were crusaders, and both saw a golden opportunity to put forest pathology on the map by quickly accepting the challenge of blister rust. The fight to contain chestnut blight had been hopeless from the start, because of its extreme virulence and uncontrollable spread, but blister rust was different. Here was a chance for success—it might be possible to eradicate incipient infections or to control the disease.

Detwiler zealously went to work to organize the attack. The first order of business was to find out how much white pine planting stock had entered America from abroad and exactly where it went, and then to inspect it for possible infection. This was a large order—too large for Detwiler's small staff. Other interests were also involved. It was time to contact affected States and discuss the situation with officials on that level.

State and Canadian Cooperation

Detwiler made his initial contact with Commissioner Whipple of the New York Conservation Commission. Whipple, in turn, notified Canadian officials, State foresters, and conservation groups and requested that they send representatives to a meeting to decide on a course of action. The meeting took place in 1910 in New York City. The consensus of representatives gathered there was that:

- State and Provincial nursery inspectors should contact all nurseries in their States and Provinces to determine if any had received white pine from foreign sources. If so, all pine seedlings in those nurseries should be examined and infected seedlings should be destroyed. Unfortunately many trees could be infected but display no evidence during the long incubation period, and the States and Provinces at that time lacked the authority to destroy plants not known to harbor a pest. (Later, laws were passed and directives were issued by the various affected States and Provinces to authorize destruction of entire plantings of white pine if even one infected plant was found.)
- State, Federal, and Provincial authorities should urge the promulgation of plant quarantines to stop further importation of white pine seedlings from abroad and regulate shipments of these plants within and among the States and Provinces.

Records show that this meeting was well attended. All Eastern States and Canadian Provinces sent delegates, who voiced concern over the threat and urged action to deal with it. The proposals cited above were unanimously adopted, and Federal, State, and Provincial plant inspectors went to work to carry out the necessary actions.

Checks on importations of foreign-grown white pine nursery stock began, and the results were disconcerting. Several million white pine seedlings shipped into the United States in 1909 came from the J. Hein Sohne nursery in Halstenbeck, Germany, a nursery known to harbor stock infected with blister rust. Shipments had been sent to 226 localities in America. In 1910 numerous other importations came from France. It was assumed that some of these plants were also infected. The stage was set for serious trouble.

Nursery inspections revealed the extent of the danger. By 1911 diseased stock had been found in New Hampshire, Vermont, Massachusetts, Connecticut, Pennsylvania, Indiana, and Ohio, and in the Provinces of Ontario and Quebec. At first, attempts were made to destroy all the diseased pine. This tactic was given up in 1915 when blister rust was first reported to be atacking native white pines in Massachusetts, and soon after in other States and Canadian Provinces. In 1914 evidence was found that some white pines in the Northeast had been infected a few years before 1900.

Acting on pressure from the affected and threatened States, Detwiler concluded that the next step was to organize a broad-based committee composed of representatives from all the States and Provinces in the eastern white pine area. The committee would analyze plant pest problems and recommend actions to deal with them.

Detwiler envisioned a committee with sufficient status, prestige, and political clout to influence public agencies and appropriation bodies. He obtained the support of Harris A. Reynolds of Massachusetts, a staunch forest conservationist. In 1915 they formed a group initially called the American Plant Pest Committee, composed of four members from each of the Eastern States and Provinces. Its declared purpose was to keep the public informed of dangerous plant pests and to secure measures for their eradication or control before they became too widely entrenched or too costly to combat.

Within a short time blister rust reached such overwhelming proportions that the committee's attention was focused on dealing with that problem alone. Consequently it became known as the Committee on the Suppression of Pine Blister Rust in North America.

The Role of Plant Quarantines

The further importation of white pine nursery stock into the United States was halted by enactment of the Federal Quarantine Law, which was approved by Congress in August 1912 largely due to pressure from Massachusetts. Within a month the Acting Secretary of Agriculture issued "Federal Quarantine No. 1," which prohibited the importation of any white pine species native to the United States

from any country in Europe, including Russia. It soon became clear, however, that this quarantine was not broad enough to be fully effective since other sources of white pine were omitted. It was superseded in 1913 by "Federal Quarantine No. 7" which prohibited importation of any five-needle pine from any country.

In November 1914 Canada also instituted a quarantine on all white pines from all foreign countries. This action eliminated further foreign sources of infection to North America, and the domestic spread of blister rust became the more important problem. An appeal was made to nurserymen not to ship white pine or *Ribes* nursery stock into the Rocky Mountain and other western white pine areas. This effort at voluntary cooperation failed, so "Federal Quarantine No. 26," later amended as "Domestic Quarantine No. 63," was placed in effect to try to prevent the spread of blister rust from the East to the West in shipments of diseased host plants. This quarantine became effective on May 1, 1917. It was hoped that by means of these foreign and domestic controls, the white pine forests of the West would be isolated from all sources of infection. The Canadians took similar steps to protect their western Provinces.

As it turned out, this hope was unrealistic. Blister rust had actually reached the West at about the same time as it reached the East, in a shipment of nursery stock from France which arrived in Vancouver, British Columbia, in 1910. However, this infection went undetected until 1921 when it was discovered on native white pines and cultivated black currants in that vicinity.

This is but one of many examples that show how far behind the true spread of infection scouting often was. Plant quarantines were at best a delaying tactic since enforcement was not totally effective and could not be made so. Numerous violations to quarantine regulations were detected by inspectors each year. Nonetheless, quarantines played an important role during the early years of the Blister Rust Control Program and received much attention by both State and Federal personnel.

Genesis of the Blister Rust Control Office

As a result of extensive proposals accepted by the Committee on the Suppression of Blister Rust during 1915, Dr. Metcalf realized that the developing action program was beginning to mushroom. The control measures became so time-consuming that they were seriously disrupting his research work. Late in 1915 or early in 1916, he and Detwiler called on Dr. William A. Taylor, chief of the USDA Bureau of Plant Industry (BPI). They proposed that the research phases of the Blister Rust Control Program, which now needed more attention than ever, be retained in the Bureau's Office of Forest Pathology, but that the action phases of the Program designed to deal directly with the disease be removed from Forest Pathology and established as an independent unit within the BPI. Taylor approved this plan, and within a short time it also gained Departmental approval. The Office of Blister Rust Control came into being.

Detwiler was appointed director. As assistant he selected a young graduate of Massachusetts Agricultural College, James F. Martin, who held a graduate degree in pathology and a doctorate in entomology. Detwiler was much impressed with Martin's thoroughness and enthusiasm for the scouting and nursery inspections he was conducting for the State of Massachusetts. Martin was put in charge of the cooperative blister rust program beginning to form in the Northeast.

To handle the western program, Detwiler engaged a young "eager-beaver," Gilbert B. Posey. As one of Metcalf's blister rust scouts, Posey was studying rust infections at Kittery Point, Maine. Prior to duty in World War I, Posey had done extension work at Oregon Agricultural College in Corvallis. He also had experience with western plant problems and knew many experts on western plant pests.

In 1919 Detwiler summarized the state of the blister rust control program. His conclusions, in condensed form, were approximately as follows:

- Experiments conducted on an extensive scale since 1916 demonstrated that practical and effective measures for the control of blister rust locally had been developed by destroying wild and cultivated *Ribes* within a comparatively short distance of the pines—a distance of 200 to 300 yards being sufficient to prevent serious damage.
- Unskilled laborers could be quickly taught by trained supervisors to find and destroy at least 95 percent of the wild *Ribes* in going over the ground once. Bushes missed were usually small bushes growing in underbrush. Indcations were that control areas should be gone over again at 5- to 10-year intervals to remove newly established bushes.
- Checks on pine infections disclosed that *Ribes* eradication was effectively controlling the rust.
- Cost of *Ribes* removal average 42 cents per acre.
- Blister rust infection on pine was increasing rapidly in the Northeastern States, and the disease was widespread in Wisconsin, Minnesota, Ontario, and Quebec. There was abundant evidence of the destructiveness of the disease to young pines as well as to merchantable trees. The manner of infection was coinciding with predictions of pathologists, and bore out the fear that the destructive power of the rust would be severe in America.

Figure 5.—Leaders of the Federal-State Blister Rust Control Program. Photo taken March 1962, toward the close of the program. Left to right: Gilbert B. Posey, Samuel B. Detwiler, James F. Martin, Conrad P. Wessela, and Warren V. Benedict. Detwiler ran the rust program in the early years, and Posey and Martin assisted him. Martin replaced Detwiler in 1933 and headed the work until 1954 when Benedict took over. In 1956 Wessela became Benedict's assistant. (Photo from the author's collection)

- Individual pine owners, towns, and associations were cooperating with State and Federal government in protecting their pine stands through *Ribes* eradication. Cooperation could be expected to increase.
- White pine blister rust had not been found in the western half of the United States or Canada. The abundance of *Ribes* in the sugar pine and western white pine forests, along with the rugged terrain where the pines grow, much of it inaccessible, would make control of blister rust *difficult, if not impossible*. The principal safeguard to these forests lay in the strict enforcement of quarantines that prohibited shipping five-needle pines and *Ribes* west of the Great Plains.

Following Detwiler's review, the Committee on the Suppression of Blister Rust endorsed the program he proposed with several recommendations.

First, the Committee recognized the great importance of the five-needle pines of America as valuable forest trees in respect to their high stumpage value, rapid growth, general utility, ability to reproduce naturally, and ready adaptability to forest and ornamental planting. The Committee also recognized that several other species of five-needle pine grew in the western mountains at high elevations, often in pure stands, and possessed high watershed and scenic value. The Committee pointed out that in addition to their commercial value, eastern white pines were highly regarded for their scenic value, interspersed as they often were with hardwoods, which formed an attractive admixture, particularly around the many lakes in the Northeast. They believed that the scenic value of white pine was even greater than its commercial value.

The Committee endorsed local control of selected stands of white pine and recommended the destruction of *Ribes* within a distance of 200 to 300 yards of such stands of native and planted white pines for which owners would support protection. They urged a vigorous campaign to encourage planting of white pines on nonagricultural lands

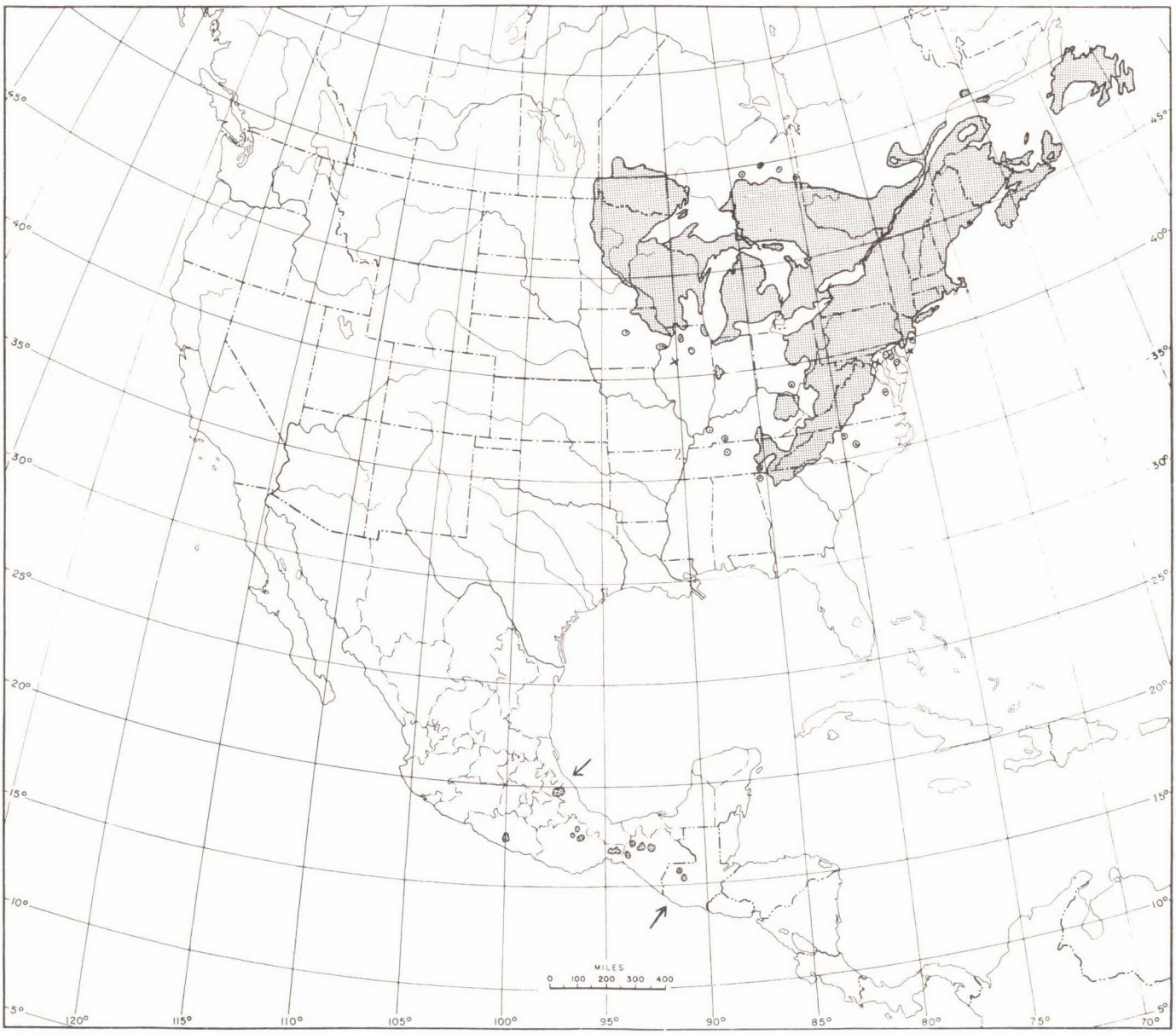

Figure 6.—The natural range of eastern white pine, *Pinus strobus*, in United States and Canada—principally the North Atlantic seaboard and Great Lakes regions, and the Allegheny and Appalachian Mountains.

(Forest Service photo, F 506631)

with proper precautions against infections by blister rust. They also recommended that the cultivated black currant, *Ribes nigrum,* be outlawed by all States in which white pines grew.

The Committee reaffirmed a position taken in previous meetings: that responsibility for control of blister rust rested with the forest owner. However, they recognized a need for public aid to study rust behavior in pine stands, to continue scouting work, to conduct extensive educational programs to obtain owner cooperation, and to continue development and improvement of methods for searching out and eradicating *Ribes.*

Finally, the Committee endorsed a cooperative effort on the part of Federal, State, and local authorities to deal with the problem of blister rust, under the leadership of the newly established Office of Blister Rust Control (BRC).

As a result of this support and the strong desire of the States to protect their white pines, Detwiler and his BRC force were ready to organize for the job ahead. He faced a unique situation: blister rust work was the first attempt on an organized scale to control a plant disease in America by removal of its alternate host plant. There were no precedents to follow. It was necessary to "feel the way" and to change features of laws, quarantines, and control procedures to meet new problems and conditions as they developed.

While much was known about blister rust, much else was not known, particularly how the disease would spread, develop, and ultimately damage pine in its new American environment. Detwiler realized it would be necessary to rely heavily on research studies conducted by the Office of Forest Pathology and by universities, and to augment these efforts with investigations by Blister Rust Control personnel.

From the beginning, States, towns, and local groups and individuals took a keen interest in the cooperative approach. The problem was widespread, and the disease recognized no property lines. In addition the job was far too big and too costly for any one group or State to handle. People were willing to accept all the Federal help they could get.

Detwiler was quick to recognize that the cooperative approach was the only one to follow. Much of the blister rust was on private lands, and Federal personnel lacked authority to enter State or private lands or to enforce State laws unless authorized to do so by the States.

Through frequent meetings, Detwiler's staff urged the States to become active in dealing with blister rust. Thirty-three of the States where white pines grew responded by enacting laws for the control of the disease and by expressing their willingness to cooperate with Federal authorities. The 25 States in the eastern white pine range were: Connecticut, Delaware, Georgia, Illinois, Indiana, Iowa, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, West Virginia, and Wisconsin. Those in the West were: California, Colorado, Idaho, Montana, Oregon, Nevada, Wyoming, and Washington.

Most cooperating States contributed direct financial assistance or provided services such as office space, equipment, supplies, and vehicles to the State BRC Program. Many States contributed both funds and services. When both State and local funds were available, they were often used to pay the wages of seasonal laborers engaged in *Ribes* eradication and other field activities. Federal funds were used to pay the salaries of permanent Federal personnel assigned to blister rust work and to provide other technical services for which the Federal BRC Office had direct responsibility.

In States where the existing laws were not adequate, special blister rust control laws were enacted. The agency responsible for enforcing these laws varied from State to State. Some States vested authority in their State Department of Agriculture and others in their State Experiment Station, Forestry Bureau, or Conservation Commission. In general, laws gave the States authority to enter private lands, to restrict the movement of plants through quarantines, to inspect plant nurseries, to destroy host plants, to compensate owners for plants destroyed, to establish control areas, to cooperate with other agencies in suppression work, and to provide a penalty for noncompliance.

By clearing applications for positions in the Federal Blister Rust Control Program with the States and then appointing personnel as agents, the Federal Blister Rust Control Office gained two important advantages. First, under this arrangement the U.S. Civil Service Commission could approve appointments for indefinite periods pending later determination of eligibility through competitive examination, or the Commission could waive this requirement entirely. Second, Federal agents acceptable to a State could be deputized as State employees and thus empowered to act for the State. This arrangement worked well, and Federal agents were headquartered in the offices of their State counterparts. Owing to their technical expertise, they were often permitted to manage blister rust control while carrying out State laws. This method of operation was as close as Federal–State cooperation could get.

The work fell into seven categories: (1) Searching for infections of blister rust throughout the white pine areas of the United States to keep a close check on rust spread; (2) enforcing Federal and State quarantines by stationing officials at strategic railroad centers during the fall and spring when most plant material was shipped; (3) studying rust infection centers to learn how the disease was acting in each locality; (4) conducting information campaigns to acquaint local pine land owners and the public with the problem and to secure their cooperation and support in dealing with it; (5) locating and mapping white pine areas that would need control work; (6) improving methods of searching for and eradicating *Ribes* and lowering costs, by performing experimental *Ribes* eradication work and testing new methods and procedures; and (7) urging private pine owners to eradicate *Ribes* on their properties, under a program of dollar–for–dollar matching between public and local funding.

Under these arrangements and guidelines the Blister Rust Control Program began to take shape. Dr. James Martin, Detwiler's assistant in charge of the program for eastern white pine, placed Federal blister rust control leaders in States where the situation was critical. As time passed a State would be divided into districts and a Federal agent would head up the work locally. Detwiler's other assistant, Gilbert Posey, was busy in the West. His principal job at

the outset was to scout western pine areas to determine if blister rust had crossed the Great Plains.

During the Detwiler years the control program was launched in the Northeast and substantial progress was made in cooperative control. Work was also begun in the North-central States, particularly Wisconsin, Michigan, and Minnesota, the southern Appalachians, and the Far West, and some progress was made in those regions. The cooperative approach that was proving so successful in the Northeast was followed in the other white pine areas, along with the formation of local committees of prominent persons associated in some way with forest conservation to support and guide the control effort. All basic activities needed to round out and develop a sound effort were laid down during this era and carried forward to the program's end.

The commercial white pine growing sections of the country were divided into regions. At the height of program activities, five regions existed (see figure 7): Northeastern, with Edmund Filler in charge; North-central, with Henry N. Putnam in charge; Southern Appalachian, with J. Curtis Ball in charge, followed by John George; Northern Rocky Mountain with Stephen N. Wyckoff in charge, followed by Herman E. Swanson; and Pacific Coast, with Warren V. Benedict in charge, followed by Thomas H. Harris.

In 1933 some agencies within the U.S. Department of Agriculture were reorganized. As a result blister rust control was removed from the Bureau of Plant Industry and assigned to the new Bureau of Entomology and Plant Quarantine.

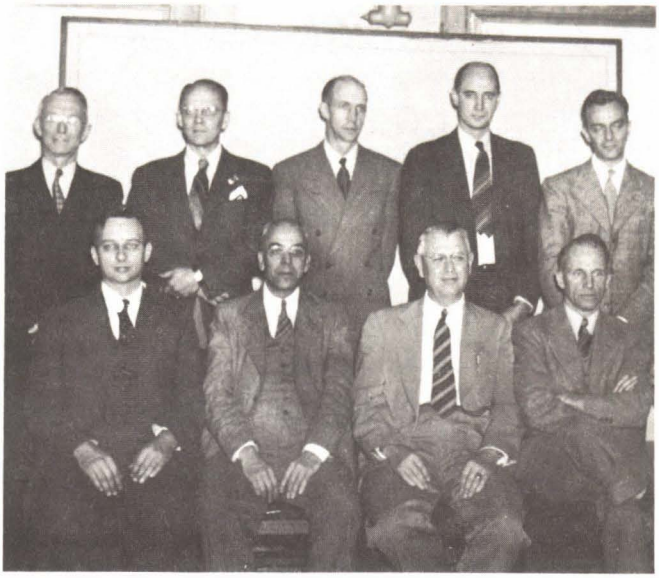

Figure 8.—Blister Rust Control Program leaders of the 1940–50 period. Back row, left to right: Edward Milstead, administrative officer, Division of Plant Pest Control, Bureau of Entomology and Plant Quarantine, USDA, Washington, D.C.; Warren V. Benedict, leader, Pacific Coast Region; Herman E. Swanson, leader, Northern Rocky Mountain Region; L. Kenneth Wright, assistant chief, USDA Division of Plant Pest Control; and Elmo St. Clair, assistant administrative officer, Division of Plant Pest Control. Front row, left to right: J. Curtis Ball, leader, Southern Appalachian Region; Edmund Filler, leader, Northeastern Region; James F. Martin, Chief, Division of Plant Pest Control; and Henry N. Putnam, leader, North-central Region.

(Photo by USDA Bureau of Entomology and Plant Quarantine)

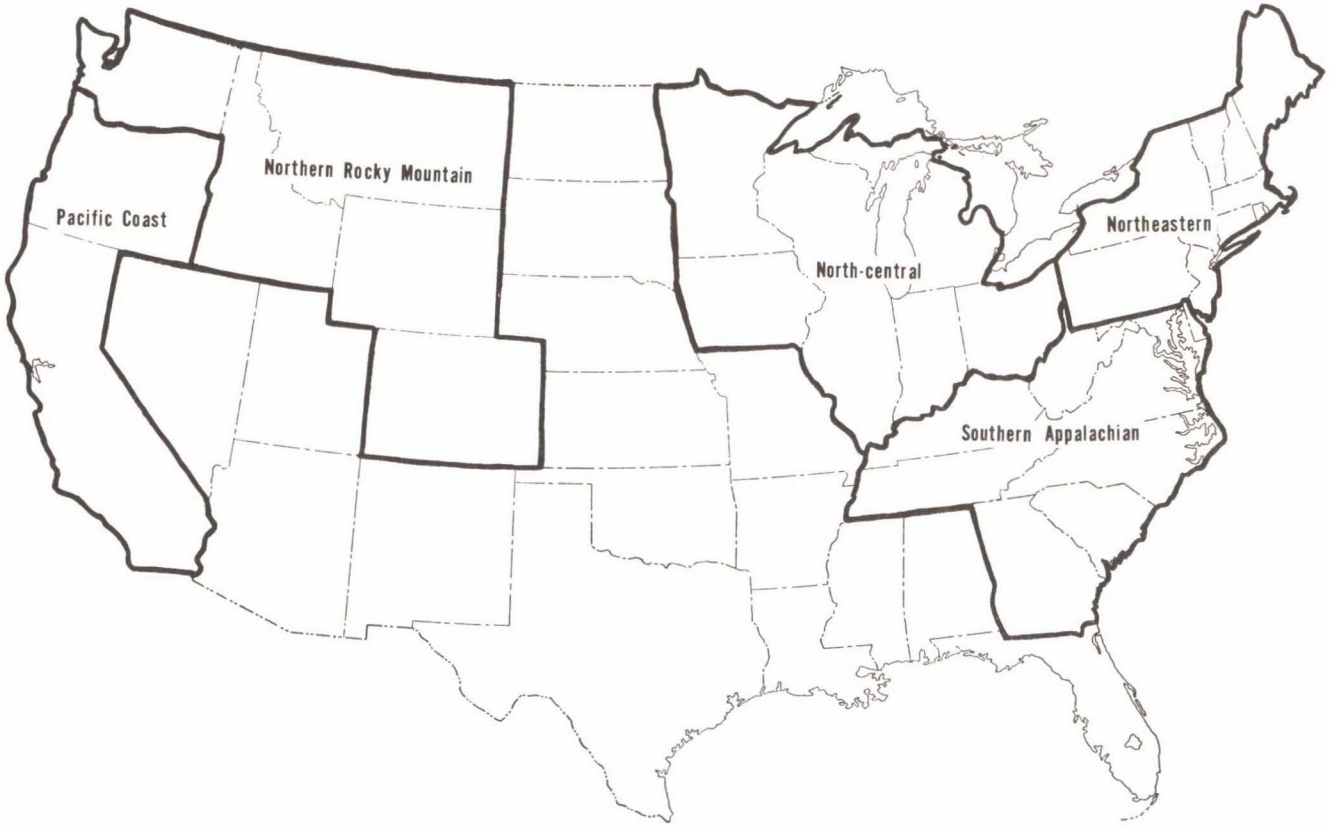

Figure 7.—The five regions of the Blister Rust Control Program at the height of activities, from the mid–1930's to the mid–1960's. In the earlier period there were two big regions, Eastern and Western. The five created later were called Northeastern, North-central, Southern Appalachian, Northern Rocky Mountain, and Pacific Coast regions.

The Federal Perspective, 1915–41

Federal Financing for Blister Rust Control

From 1915, when the first Federal money was available specifically for blister rust, until 1939, funds for white pine blister rust control were earmarked in the annual Agricultural Appropriations Act. In 1940 Congress passed the Lea Act, which defined the coordination of control work more precisely. The Act authorized the Secretary of Agriculture to use funds appropriated for the control of blister rust to prevent its spread and to eliminate the disease from all forest lands, regardless of ownership. It also provided that, at the discretion of the Secretary of Agriculture, no Federal funds should be expended on non–Federal lands until matching funds equal to proposed Federal expenditures on those lands were made available. An exception was made for places where lands were so intermingled that work on non–Federal lands would be necessary to protect the Federal lands. (See Appendix IV.)

Federal funds appropriated for blister rust control from 1922 to 1933 averaged about $400,000 annually. This sum, in addition to funds contributed by cooperating States and other sources, was less than what was needed to carry out the program. Between 1933 and 1941, allocations of funds and manpower from the emergency relief work programs of the early Roosevelt years were sufficient to boost blister rust control to levels more nearly in keeping with the need. More progress was made in protecting white pine during the emergency program years than during all previous years. Emergency funds were gradually reduced after 1936 and ceased after 1941.

Cooperation With Other Federal Agencies

During its formative years, the Blister Rust Control Program dealt principally with non-Federal lands. Most early infections occurred in white pine areas in private ownership. Formal cooperative agreements were worked out with the affected States to define Federal and State responsibilities. But as the disease spread and control work to halt it expanded, lands in public ownership became involved especially in the West.

At first, informal agreements were developed between the Office of Blister Rust Control and Federal administrators of public lands on which BRC personnel were being encouraged to extend the program. Formal memoranda of understanding were ultimately developed between the Office of Blister Rust Control and the USDA Forest Service, and later between the U.S. Department of Agriculture and the U.S. Department of the Interior. These agreements spelled out the role of the Office of Blister Rust Control on public lands. They recognized the responsibility of the BRC office to provide leadership and technical direction for all classes of lands and the need for that office to coordinate all facets of blister rust control work to maintain a unified program. When the Lea Act went into effect in 1941 these roles of the BRC office were specifically identified in the Act, and appropriations were made to allow the Bureau of Entomology and Plant Quarantine, which had taken over blister rust control from the Bureau of Plant Industry in 1933, to carry out its recognized responsibilities.

Besides the USDA Forest Service, other Federal agencies participating in blister rust control work were the National Park Service, the Bureau of Land Management, and the Bureau of Indian Affairs, all within the Department of the Interior. The BRC Office assigned personnel to work with these Federal agencies. As in the case of private lands, leaders were usually given permission by their Federal counterparts to direct work on Federal lands, acting as agents for that Federal agency.

THE BLISTER RUST CONTROL PROGRAM IN THE EASTERN UNITED STATES

The Northeastern Region

In the early days of blister rust control the entire eastern white pine belt was considered one region. It encompassed Maine, Vermont, New Hampshire, Connecticut, Rhode Island, Massachusetts, New York, Pennsylvania, New Jersey, Delaware, Maryland, Virginia, West Virginia, Kentucky, North Carolina, South Carolina, Tennessee, Georgia, Minnesota, Wisconsin, Michigan, Iowa, Illinois, Indiana, and Ohio. In the early 1930's as work expanded rapidly, this eastern region was divided into three separate regions—Northeastern, North-central and Southern Appalachian. Work was organized and conducted along lines developed in the Northeast. There were differences, however, in working conditions in each region and therefore in the methods used to do the work. Some of these differences will be covered in this chapter and in the following two chapters.

A Brief History of the First BRC Regional Office

At the request of the States, following the 1919 conference of the Committee on the Suppression of Pine Blister Rust in North America Detwiler decentralized Federal phases of the BRC program. To head the first regional office in Cambridge, Mass., he selected Edmund Filler, a graduate forester from Syracuse University, who had worked on *Ribes* eradication in Massachusetts under Dr. Martin during the summers of 1916 and 1917. He supervised 45 laborers on a survey of cultivated *Ribes* in western Massachusetts. Filler became a field assistant working with cooperating States on blister rust inspection. He spent the winter of 1918–19 in the State Forester's office in Concord, N.H., preparing the first manual on *Ribes* eradication. It was used throughout the Northeast for several years.

In 1921, Detwiler sent Filler to Minnesota and Wisconsin to locate and map rust damaged white pine areas suitable for public demonstration purposes. Filler also went briefly to Kansas City, Mo., and Sioux City, Iowa, as a blister rust quarantine inspector.

At Cambridge, Filler had under his supervision at first a paymaster, a clerk to compile eradication records, a typist-stenographer, and an office supervisor. In June 1921 recordkeeping was turned over to the cooperating State and district leaders. The people left moved into free space in the Appraiser's Store in Boston where the office remained until 1933. Then came the emergency relief work programs, which put thousands of laborers to work on *Ribes* eradication. The northeastern regional office was forced to adjust quickly. During an interview with me, Edmund Filler described the events of that time in this way:

> Our little office nook in Boston was in no way suitable for the expansion we faced, so it was back to Cambridge where BRC initially took over one entire floor of the Post Office Building. I had only four experienced people at the start. We recruited WPA people for office duty, but none had any experience in government work and little experience in private employment. Our big job was to start from scratch with a training program—to train our WPA help to prepare payrolls from time sheets sent from the field, to audit travel vouchers, and to do other necessary government office jobs.
>
> At the start, we had little office equipment, but this was soon remedied. When the Sugar Rationing Board was abolished, we inherited everything we needed.
>
> It was necessary to work the office force two 6-hour shifts a day [from 8 a.m. to 8 p.m.] for several months to keep up with the work. Some 20 workers were used on each shift, with the regular BRC personnel doing double-duty—and at no overtime pay. We maintained close contact with the State WPA Administrator's Office in Boston to keep abreast of regulations and procedures.
>
> As for transportation, we had passenger cars for our State and district leaders, and about a dozen trucks were obtained from the Gypsy Moth Project of EPQ—as were a big supply of snowshoes. In most cases, WPA labor was able to get to and from work without need for transportation. In some cases, the WPA administration permitted a laborer to use his personal car to transport workers to and from the job on a 7 cents-per-mile reimbursement basis.
>
> The peak years for employment on *Ribes* eradication were 1935 and 1936, when WPA and CCC provided a total of over 8,600 men. These programs continued at a reduced rate until the onset of World War II. In 1950 the regional office was moved to Greenfield in western Massachusetts to a building housing other activities of the Bureau of Entomology and Plant Quarantine. Then, when the Forest Service took over BRC in 1954, the BRC regional office was abolished and its personnel transferred to the Forest Service regional office in Upper Darby, Pa.

So ends the history of a key center of activity during the peak years of the BRC Program.

Advent of the BRC District Leaders

During the years that Edmund Filler managed the first BRC regional office Detwiler was expanding and improving the BRC Program from his Federal base. In 1922 Federal funds were increased and Detwiler and Martin decided to strengthen Federal leadership in the Northeast. They wished to use available Federal funds to pay Federal BRC leaders, and asked that the cooperating States and local agencies use their funds to pay temporary labor and to provide supplies and equipment. Funding by both the Federal government and the cooperating State and local agencies was to be on a matching basis for work on private lands. This proposal was agreeable to all parties, and it became the standard procedure for BRC funding through the years except for the emergency relief programs.

By the mid–1930's Federal BRC leaders with some blister rust experience were assigned to several States. Most were paid from Federal funds; a few were paid from State funds. Detwiler's idea to divide the States into districts with a Federal BRC leader in each was accepted by the cooperating States.

Suddenly Filler and the State leaders were confronted with the formidable task of recruiting and training some 40 people for district leader positions. Men were selected by the State leaders with the assistance and consent of cooperating agencies. While some of these recruits had blister rust experience, most had none. So the training for these new leaders had to be extensive. As an orientation, three 1-week training sessions were conducted to introduce new men to the essentials of their jobs. Regional conferences were then called periodically to provide additional training. These conferences soon became an established part of the northeastern regional BRC Program and were continued throughout its life.

Once trained, the new Federal district leaders worked closely with their counterparts at both the State and local levels. They were deputized as State agents, which enabled them to enforce State laws. In time it became difficult to distinguish between State and Federal BRC leaders since the States allowed the "Feds" to manage blister rust control as their representatives.

Role of the BRC District Leader

Under this decentralized arrangement, the person responsible for getting things done was the district leader. Like the district ranger in the USDA Forest Service, the BRC district leader was the man on the scene who dealt with local people and local problems. The success or failure of the Blister Rust Control Program in the East rested largely on his shoulders, and it was to him that local people turned for help.

How well did he perform his role? Results speak for themselves: he sold the BRC Program; he directed it; he appeared before the select committees of the townships; he was, in fact, the forerunner of the Federal extension forester. In a region noted for its conservatism, the BRC district leaders were instrumental in getting over 43,000 pine woods owners to furnish labor and to contribute nearly $528,000 out of their own pockets to the program. Moreover, the leaders helped raise $1.2 million from township appropriations, $242,800 from county appropriations, and $4.8 million from some of the cooperating States—a total sum that more than matched Federal contributions to the cooperative Blister Rust Control Program (excluding the Emergency Relief Program era when no matching funds were required).

This record, of course, also reflects the deep desire of local citizens to protect their white pine stands. And one job of the BRC district leader was to channel this public concern into appropriate action.

Information and Service Activities

Developing local interest in taking action against blister rust was the prime objective of the whole cooperative approach. State and district leaders did an outstanding job of selling the Blister Rust Control Program. A chief hurdle at first was not public apathy but rather a feeling of worried hopelessness. People in the East had seen the severe damage an introduced tree disease could inflict upon an important forest tree when the American chestnut was wiped out. They were afraid that their white pines would go the same way because they feared blister rust could not be stopped. This attitude may have been due to the dire predictions made by pathologists who had studied the blister rust problem in Europe.

W. Stuart Moir in 1920, Perley Spaulding in 1922, both also pathologists of the Bureau of Plant Industry, and John Boyce in 1925, studied blister rust in Great Britain, Belgium, France, Switzerland, Germany, and Denmark. They confirmed the conclusions already reached by European foresters. *Pinus strobus* was being exterminated by this disease throughout Western Europe. Snell and Metcalf made much the same prediction with respect to the damage blister rust would cause in America. Metcalf stated publicly, "White pine can no longer be grown in the Eastern United States in the presence of *Ribes.*"

Blister rust was often compared to chestnut blight, and in the early public information, State and district leaders emphasized this relationship. Later, when more was known about the behavior of blister rust in the East, the contrast between the two diseases was explained and the reasons behind the good prospects for control of blister rust were detailed.

District leaders established demonstration areas to show the damage blister rust could cause and the effectiveness of *Ribes* eradication in checking damage. They attended public meetings and gave talks about the problem, often illustrated with slides or motion pictures. They prepared for local fairs and other public gatherings. They developed printed materials and made sure that these items were widely circulated. Most important, they contacted local pine woods owners, explained the blister rust problem to them personally in their own woodlots, and solicited their cooperation in applying control measures.

By and large, the Blister Rust Control Program was regarded favorably by the public, and cooperation was good. Aware of the need for public support, program leaders worked hard to make a good impression, and information and service activities received attention from leaders and workers alike.

The Black Currant Eradication Project

All white pine States followed through on the recommendation to rid American communities of *Ribes nigrum* by enacting laws to ban these plants. It was the district leader who spearheaded local movements to eliminate the black currant. He contacted homeowners and sought their cooperation in destroying black currants. He had a high degree of success in obtaining such cooperation. In a few cases, holdouts had to be handled by State regulatory authorities, but these officials were reluctant to enforce the law unless no other solution could be found. A few States reimbursed owners at a rate of 50 cents for each plant destroyed; others offered replacement plants of different species.

Within 10 years, *Ribes nigrum* had been eliminated for

all practical purposes from communities in and near the white pine growing areas of the East. Through this one action, the damage potential of blister rust was sharply reduced—so sharply in fact, that had no further *Ribes* eradication been done, blister rust probably would not have developed into a major disaster in the Northeast.

Locating and Mapping Pine Stands

The first step in applying control measures to eradicate *Ribes* was to determine the location of adequately stocked white pine sites and to size up the *Ribes* situation and working conditions in the vicinity of such stands. In the Northeast this work was done by "roadblocks."

Since the Northeast was crisscrossed by many roads, it was relatively simple to locate pine stands in the open spaces between several intersecting roads. Each "roadblock" was numbered for identification. Mapping was usually done during the winter months when hardwood trees were bare of leaves and the pines were highly visible. This work was often done on snowshoes in sub-zero temperatures.

"Roadblock" maps formed a part of the blister rust control work record and were used as a basis for planning *Ribes* eradication work. Before deciding on the annual blister rust control budget, town selectmen commonly would request a detailed review of *Ribes* eradication needs from the district leader, who prepared his estimates from pine surveys in roadblocks.

Two methods were used to make pine surveys. The first involved survey personnel who examined a pine stand and sampled segments of the stand by pacing across the area on a compass course to maintain proper direction and spacing. Enlarged sections of U.S. Geological Survey maps of each "roadblock" were used to detail information pertinent to the *Ribes* eradication job. The second method utilized aerial photographs with a scale of 4 inches to the mile. From these photographs, the outline of white pine areas could be identified along with the principal physical features of the landscape, such as meadows, farmlands, brush areas, buildings, and streams. Some ground inspections were needed to check the condition of the pine, determine age classes and note *Ribes* occurrence. In New York, surveys by aircraft were used extensively to locate pine in remote sections of the State.

Each pine stand was judged on the basis of pine stocking. At maturity, 50 trees per acre was the minimum number that would justify control work. Stands that qualified on that count were further classified on the basis of age and vigor. The following classes were eliminated from control consideration: (1) Pine to be harvested within 20 years, where there was little or no chance that reproduction would follow cutting; (2) stands that had little or no potential value because of their poor quality and had little chance of reproduction; and (3) isolated stands of less than 5 acres. These standards were applied to natural stands of white pine. They were modified somewhat in surveying farm woodlots, plantations, public parks, and private estates where the ornamental value of the pine was considered in each individual case.

Pine stands that met the standard for control work were further examined to determine the width of the protection zones from which *Ribes* would need to be eradicated. The width was determined by the district leaders and varied from a minimum of 100 feet bordering swamps to 900 feet in open land. Where cultivated black currants were present in the vicinity, the protection zones had to be as much as a mile wide.

Most stands of white pine in the Northeast were mapped in this way. Surveys were continuous because changes in pine stands occurred frequently due to logging, land clearing, and fire and storm damage. The big blowdown resulting from the hurricane that struck New England in September 1938 is an example of how a natural disaster could affect control work. Pine stands were severely damaged and it was necessary to reassess them on the basis of reproduction occurring in salvage areas.

The 1938 hurricane caused 50 percent or more blowdown on 600,000 acres, which amounted to a loss of 2.6 billion board feet of timber. About 80 percent of the windthrown timber was old white pine. Fortunately, 1938 was a good seed year for pine, and widescale pine reproduction occurred in timber salvage areas. District leaders and their workers assisted the Federal New England Timber Salvage Administration in mapping areas struck by the hurricane. Filler, with the approval of the State Forester of New Hampshire, arranged to use a Bureau of Entomology and Plant Quarantine autogiro and pilot to map blowdown areas aerially. A large portion of the windthrown timber in southern New Hampshire was mapped in this manner.

Protecting Forest Nurseries

In the Northeast, numerous forest nurseries were operated by Federal, State, or commercial agencies to produce white pine planting stock. A more thorough control job was required around these nurseries than around pine stands in general. Complete *Ribes* eradication had to be undertaken, and wider protection zones had to be cleared.

Since these nurseries provided pine planting stock for several states, it was essential to insure that this stock did not become infected with blister rust. Both State and Federal governments regulated interstate shipments of white pine through plant quarantines. As a result of this nursery sanitation work, white pine planting stock was kept free of infection and continued to be shipped interstate.

Planned and Supervised *Ribes* Removal

Ribes eradication was the bread-and-butter job, the payoff resulting from other blister rust control activities. It was a summer job, one that could be effectively undertaken only during the period when *Ribes* were in leaf and readily visible to search crews.

In the spring, usually beginning in May after local blister rust control budgets had been passed, word was spread by newspapers and radio that laborers were being hired for *Ribes* eradication work. District leaders arranged for a central gathering place (usually the town square) to meet the seasonal labor force. Most pine areas to be worked were within walking distance, so transportation was a minor problem. Where the pine areas were too far for walking, workers were transported to and from town in

private automobiles. A few Government trucks were also used for this purpose. Because of the extensive road network in the Northeast, camps were rarely needed (except during the CCC and other emergency work periods). Prior to the CCC program the only camps were on State lands in New York.

A supply of local labor was almost always available. As the years passed, the "locals" looked forward to the opening of the *Ribes* eradication season as a source of supplementary income. Many workers came back year after year. Large numbers of teachers and college students worked on the project since the *Ribes* season coincided with their summer vacation. This provided a nucleus of trained men who were employed as crew foremen, scouts, and crew leaders, thus minimizing the annual training job.

Work by local labor was financed by contributions from States, counties, towns, and individual landowners matched by Federal funds. The work force fluctuated from year to year but was never large enough to get all work done. In 1932 the *Ribes* eradication effort reached its lowest level.

The Emergency Relief Work Program started in 1933 and by 1936, *Ribes* eradication employment reached an all-time peak of 8,728 laborers including CCC enrollees from 125 camps. All field work was supervised by the BRC district leaders.

During this emergency work period contributions from local sources were sharply reduced but never disappeared completely. When the emergency programs ended contributions from States and local sources resumed at former or even expanded levels.

How *Ribes* Eradication Was Accomplished

In the beginning many experiments were tried to determine the best formations and spacing between individual crewmen. Different methods of moving across work areas and of searching for *Ribes* were also tried. At first crews consisted of six or eight men with a leader. Keeping the workers aligned and attentive to the work at hand posed a problem. It was soon determined that an 8-man crew was unwieldy and inefficient, and smaller crews were preferred. In time general methods for eradicating *Ribes* evolved. These are described in the following paragraphs.

Figure 9.—Ribes eradication crew working in stand of native white pine in New England in the late 1920's or early 1930's.
(Photo by USDA Bureau of Plant Industry)

The Scouting Method

The scouting method was used in areas where *Ribes* plants were few and occurred largely in patches or "*Ribes* sites." An experienced scout learned to recognize the sites where *Ribes* were most likely to grow. The success of this method depended upon the knowledge, skill, and conscientiousness of the scout. He had to be a good woodsman, have a keen eye, and possess a knowledge of *Ribes* species and their growth habits.

Many areas where white pine grew supported few or no *Ribes* and could be satisfactorily worked by the scouting method. Scouts were selected with great care and thoroughly trained, and they usually returned year after year to the *Ribes* eradication job. Men assigned to scouting during the summer months were usually those who mapped white pine areas during winter. They worked on blister rust year-round, and became experienced in *Ribes* control and very familiar with the terrain in which they worked.

The Crew Method

The crew method was used in white pine areas where *Ribes* were uniformly distributed and a systematic ground search was necessary. Five crewmen were deployed in line about 8 to 20 feet apart, depending on ground conditions and the abundance of *Ribes*. The leader worked 15 to 25 feet behind the line, following a zigzag course, and observed the speed and spacing of the crewmen, kept them aligned, and checked for overlooked *Ribes*.

To insure that all areas were covered as well as to guide the crews and keep the proper alignment, small pieces of paper about 2.5 inches square cut from glossy magazine pages were scattered along the ground or fastened to branches of small trees or shrubs by the outside man of the crew on its trip across the workblock. The man who laid the trail was assigned a position from which he could guide the direction of the crew on its return trip. In this manner, the entire workblock was systematically covered.

The *Ribes* plants were pulled up by the roots and deposited, roots upward, in places where they could not root again. The *Ribes* had to be pulled carefully to get all the roots since crown portions of roots could sprout. Most *Ribes* could be eradicated by a strong tug on the stems. Occasionally, specially designed tools were needed to pry

Figure 10.—A *Ribes* crew foreman removing two large European black currant bushes from the garden of a private residence in the Northeast, early in the rust control program. (Photo by USDA Bureau of Plant Industry)

out the roots.

The Chemical Method

Where *Ribes* plants grew in rockpiles along walls and ledges, and were difficult to pull or grub out completely, a mixture of salt and borax was applied to kill their crowns and roots after stems were cut and scarified. The crowns and roots were then covered with soil. A supply of the chemical mixture in 2-ounce packages was carried by workers for this job.

The chemical herbicides 2,4-D and 2,4,5-T, in water or an oil solution depending on the time of year, were also used to kill *Ribes* where they grew in big patches. Two species—skunk currant *(Ribes glandulosum)* and wild black currant *(Ribes Americanum)*—often grew this way. Grubbing them out by hand tools disturbed the soil so that *Ribes* seed in the soil germinated readily and produced new plants. Use of chemicals avoided disturbing the soil and insured little or no regeneration of *Ribes.*

Checking and Inspecting the Work

Thoroughness in finding and destroying large numbers of *Ribes* was essential to the success of the control program. It was known at the start that 100 percent of the wild *Ribes* could not be found by the search methods available, no matter how well the workers were trained. So what degree of removal would provide adequate protection?

Experience showed that properly trained workers under skilled leaders could get about 95 percent of the *Ribes.* Those missed were usually small and well hidden or screened by brush. Studies demonstrated that a high degree of control resulted where *Ribes* were reduced to three or four small, scattered plants per acre. The goal for satisfactory work was fixed at 20 feet or less of *Ribes* live-stem—that is, 20 feet of *Ribes* canes laid end to end—left per acre. This standard appeared to provide satisfactory protection.

Three types of checks were made on crew work: (1) the foreman's observations as he worked behind the crew, reexamining the ground covered by the crew; (2) reworking a strip by the entire crew; and (3) inspections of crew work by the district leader or a checker specially trained by him.

Results of *Ribes* Eradication in the Northeast

By 1965, practically all of the 12.5 million acres of control area (containing 5.33 million acres of white pine) in the Northeast had been worked once, and a good portion had been worked more than once. About 96 percent of the area was classed "maintenance," which meant that regeneration of *Ribes* had been stopped and no additional work would be needed except where the forest cover and ground were disturbed by logging, fire, or land clearing. Examination of maintenance areas at 10-year intervals was recommended.

With *Ribes* largely eliminated near most of the white pine forest types, blister rust was under control. It no longer constituted a major disease problem in the Northeast. Today one can travel extensively throughout the white pine stands of the Northeast (or the entire East, for that matter) and only rarely see any evidence of new infection, and then only after a careful search in likely sites.

The rarity of infection has generated some criticism of the program, implying that blister rust was overrated as a serious disease and would not have amounted to much if nothing had been done. Such a position is not supported by a review of the early history of the program.

In the records are many references to early infection affecting from 25 to 75 percent of a pine stand. These references are documented by numerous photographs of extensive pine damage. Of course, in the substantial acreages free or nearly free of *Ribes,* blister rust would have caused little or no damage. But the only work done in such areas was the survey work required to confirm that they were *Ribes*-free and to eliminate the areas from further consideration. Although a bit ironic, criticism of the Blister Rust Control Program in the Northeast was partly the result of the program's success.

The North-Central Region

The Blister Rust Control Program in the North Central States was concerned with eastern white pine, but it faced some problems different from those encountered in the Northeast. White pine was a minor tree in the southern portion—Iowa, Illinois, Indiana, and Ohio. Even in its major range to the north, except for Wisconsin it was not considered as valuable as it was in the Northeast.

Continuous stands of mature white pine once extended across the three northern Great Lake States of Michigan, Wisconsin, and Minnesota, but these trees had been removed by logging, and then numerous wildfires had destroyed most pine reproduction and led to erosion of the forest soil. Natural regeneration of pine was slow. Extensive planting had to be done, and the trees were often planted where rust hazard was high. Consequently, many stands of young pines suffered extensive damage before *Ribes* eradication could halt the infection.

White pines no longer grew in large unbroken stands. Instead, they grew in scattered patches of several acres to about 1,000 acres. This patchy growth made protection and management of the trees difficult.

In addition, rust hazard was generally greater in the Great Lake States than in the Northeast, but the level varied more from place to place. After years of attempted control, efforts had to be given up in some areas, especially in the northernmost sections, because the cost of eliminating *Ribes* had become prohibitive.

Populations of wild *Ribes* were generally more abundant in the North Central States than in the Northeast, and more frequent reworkings were needed to bring them to stabilized low levels. This factor plus the higher rust hazard necessitated wider protection zones around control units which resulted in higher costs.

The land ownership pattern was also different. In the Northeast most of the pine lands were small private holdings. In the Lake States large areas of pine land were, and are, owned by Indian tribes and the Federal Government. Consequently, the North-central BRC Region's cooperative program included the Bureau of Indian Affairs, the National Park Service, and the Forest Service, as well as the States, counties, conservation groups, and individuals and required more complex arrangements in coordinating control work.

The wide variation in rust hazard within the seven-state region prompted pathologists at the University of Wisconsin to attempt to pinpoint factors which might explain the situation. Dr. A. J. Riker, head of forest pathology at the University, and his assistant, Dr. Eugene VanArsdell, conducted detailed studies of the micro- and macro-climate in several parts of Wisconsin to determine why rust was severe in certain locations and slight in others, although *Ribes* distribution was similar. This pioneering work provided information that helped blister rust control personnel realign work areas and adjust control practices. The results of this important contribution to the Blister Rust Control Program prompted researchers to undertake similar studies in other white pine regions.

Riker and his staff also did much work in developing strains of pine resistant to blister rust. Likewise, Dr. Edwin Honey, a plant pathologist employed by the BRC Office, established some 30 pine infection study plots between 1935 and 1941 to determine the distance of rust spread from *Ribes* to pine under various environmental conditions and the effectiveness of *Ribes* eradication in controlling the disease. Unfortunately, all were abandoned in 1941 before significant data could be obtained. Almost 25 years passed before additional studies on control effectiveness were undertaken. By then there was evidence that control was not effective in some sites under the *Ribes* eradication standards in current use. These later studies, chiefly the work of VanArsdell, played a major role in modifying the Blister Rust Control Program of the North-central Region.

A Brief History

Blister rust infections were first discovered in the North Central States about the same time they were discovered in the Northeast and in much the same way. In Wisconsin infections were observed in Polk County in 1913. In Minnesota, infections were first found on white pine seedlings in 1914, at Strang's Nursery in Taylors Falls. In 1917, scouts spotted rust for the first time in Michigan. In all three States, the source of infection was traced to imported nursery stock.

As in the Northeast, rust eradication was the aim at first. Both Federal and State personnel confined their attention to locating and destroying all pine seedlings imported from Europe, and to eradicating *Ribes* in the vicinity where the imported pine was planted. For a time these efforts appeared to be succeeding. However, rust soon began to appear on wild *Ribes* and then on native pine. Once again, control forces had to face the fact that attempts to eradicate the disease were fruitless. Blister rust had to be dealt with through extensive and continuous control at the local level.

Federal assistance was available to the North-central BRC Region from the very beginning. Experienced blister rusters from Detwiler's Federal staff were detailed to the Lake States to help State officials develop an organization and procedures for meeting the problem.

In 1931 a Federal Regional blister rust control office was established in Milwaukee, Wis., to provide on-site aid, and from this office Federal agents were assigned to work with State blister rust control officials. Henry N. Putnam was selected to head the Federal program. As in the Northeast, the States were divided into blister rust control districts with a Federal leader located in each.

Putnam—or "Put," as he was called—was a graduate forester from Michigan Agricultural College, class of 1917. As a youth, he had been a seasonal Federal blister rust scout in his native State, Vermont. After graduation, he served as a private in the 10th Engineers, a well-known American forestry regiment, during World War I. He was sent to France to convert spruce trees and maritime pines into railroad ties, or "sleepers," as they were called in Britain.

When his military venture ended in 1919, "Put" opted for another go at blister rust. He applied to Detwiler for a job and was quickly accepted and sent to California to become one of Gilbert Posey's original blister rust control scouts in the Far West. "Put" scouted for rust up and down the Sierras of California, and then along the coast and in the Cascade Ranges of Washington and British Columbia. He also conducted white pine surveys in Idaho. With all these experiences to his credit, "Put" went to Milwaukee to become the first blister rust control leader for the North-central BRC Region.

Work Methods Used

The first job of Putnam's newly established regional office was to find out how much white pine in the region was worth protecting and where it was located. Next came the job of locating and destroying the cultivated black currant, *Ribes nigrum*. Both jobs were begun simultaneously and continued for several years following procedures used in the Northeast.

The roadblock system used in the Northeast could not be used to describe the location of white pine because stands in the North-central BRC Region were usually small and scattered. Instead, pine areas were described by tying them into public land surveys by township, range, section, and subsection.

Scouting to locate white pine was done in the fall and winter, often under the severe handicap of deep snow and subzero temperatures. Checks on *Ribes* and pine infections were made during the summer. Aerial photographs served as base maps, and symbols were used to designate the degree of pine density and infection, and *Ribes* distribution and abundance.

Arrangements were made with the Commandant of the U.S. Coast Guard air station in Traverse City, Mich., to use helicopters and "flying boats" during the winter to map white pine from the air. During the flight, usually at 800 to 1,500 feet, it was possible to sketch white stands onto aerial maps. Stands so mapped were later examined from the ground to obtain information of *Ribes* distribution and working conditions. Use of aircraft was on a gratis basis as a part of the flight training program of Coast Guard pilots, and much of the pine in Upper and Lower Michigan was mapped in this way.

Once the pine had been mapped, it was checked from the ground and the following standards were used in designating white pine units for blister rust protection:

Character of Stands	*Size of Area*	*Minimum Stocking*
Ornamental pines	Any size	One or more groups
Public parks, resorts	5 acres	20 trees per acre.
Native stands	20 acres or more	One to 6 feet tall—200 or more trees per acre.
		Seven to 15 feet tall—100 or more trees per acre.
		⩾ 16 feet—50–75 trees per acre.
Woodlots	5 acres	50 trees per acre.
Planted pines	1 acre	500 trees per acre.
Shelterbelts	20 acres or more	10 or more trees per acre.

Resurveys of pine areas were made from time to time to reappraise the stands, after cutting or other disturbances that would affect pine reproduction.

As a result of pine survey work, a total of 1,345,745 acres of white pine were designated sufficiently valuable to justify control. This acreage plus the protection area needed for control totaled 3,888,814 acres. Broken down by ownership, the largest number of acres—691,567 (before protection zone acreage was added)—was privately held. Non-Federal public areas totaled 58,862 acres. Wisconsin had the largest number of acres—562,742 designated for control. Also high were Michigan and Minnesota. Ohio, Indiana, Illinois, and Iowa all had minor acreages.

Black Currant Removal

This work extended over a 6-year period and was conducted by State and Federal district BRC personnel after contacts were made with owners to obtain permission to destroy all bushes in white pine areas. All States had previously outlawed *Ribes nigrum* from all pine-growing sections. Cooperation by owners was almost 100 percent in spite of the fact that the law did not provide for any compensation. This was a remarkable achievement that speaks well of the relationship between the public and the Federal and State BRC personnel.

Canker Elimination

In both the Northeast and North-central regions, blister rust cankers were eliminated by pruning lower limbs of the younger pines. This practice reduced the likelihood of infection in healthy trees and removed infected limbs from diseased trees before the rust could spread into their trunks. In the flat and undulating lands of the Lake States and parts of the East, pine infections were usually confined to lower branches, and pruning significantly lowered the likelihood of infection causing serious damage to pine. In the mountainous terrain of the West where spores from *Ribes* on ridgetops could easily be blown into all portions of the pine crown, canker pruning had little control value.

Ribes Eradication

Work by scouts in areas where the occurrence of *Ribes* was patchy, and by 3- to 5-man crews in areas where every foot of ground had to be examined systematically, was done following procedures used in the Northeast. There was an important difference. In the Northeast, paper squares were used to mark crew worklanes. In the North-central region, Putnam introduced the use of spindles of white twine as lane markers; a procedure developed in Idaho.

Ribes types were also different. Six different types peculiar to the glaciated terrain of the Lake States were identified:

- In *alkaline swamp areas* composed of alder, cedar or larch, *Ribes* stalks were abundant and crew work was needed throughout. Heavy brush allowed little movement of air, so only a narrow protection zone of 100 feet was needed.
- In *acid swamp areas* the principal vegetation was muskeg or plants closely associated with it, such as Labrador tea and black spruce. Since *Ribes* species prefer alkaline soil, they were usually present only along the shoreline of the wetland. Scouts covered the wetland interior, and crews covered the edges. Protection zones extended for 900 feet.
- In *Upland hardwood* areas vegetation consisted of beech, yellow birch, and sugar maple, with white pine either mixed in with these species or in stands nearby. *Ribes* were common, and crews worked the entire stand. The protection zone varied from 400 to 600 feet and was extended to 900 feet in open areas.
- *Upland pine areas* consisted of jack, red, and white pine, often associated with oaks and aspen. *Ribes* plants were few and often completely absent except in moist spots. Scouts checked the site and outlined areas needing crew work.
- *Pastures* included cultivated fields, grassland, and savannas. Within this type were stumps, stone piles, briar patches, fence rows, and occasional large trees. Only an experienced scout knew where to look for the few *Ribes* present. Protection zones were extended to 900 feet.
- *Cultivated land* included farm crop land where *Ribes* frequented fence rows, stone piles, and farmsteads. Bushes were few or absent, and scouts were used to check these areas. A 900-foot protection zone was used.
- *Ribes* plants were destroyed either by hand pulling or by chemicals. Under certain field conditions, chemicals were more effective and less costly than hand eradication. A dilute solution of 2,4,D as a foliar spray was most commonly used, although the same chemical in concentrated dry form was sometimes applied to freshly cut *Ribes* stems to kill the roots.

On the Menominee Indian Reservation in Wisconsin Indian women were employed extensively for a number of years to find and remove *Ribes*. They were conscientious workers and their attendance records were impeccable.

Prison labor made a name for itself on blister rust control and was used widely in Wisconsin and Michigan. At first armed guards watched over prisoners at work, but prison authorities soon decided that the guards were not needed during working hours. The prisoners enjoyed outdoor work and responded with a desire to do a good job, no doubt motivated by an enjoyment of the freedom the work offered more than by the work itself. There was not one instance of attempted escape.

Aside from CCC program workers and prisoners who were quartered in camps, the only other camps for blister rust control labor in the North-central Region were in remote parts of the Superior National Forest in Minnesota. Two former CCC camps were renovated and reopened for WPA labor assigned to *Ribes* eradication. One camp was located near Ely, and the other along the Gunflint Trail, a Forest Service road north of Grand Marais. Labor was recruited from communities near work areas and transported in Government vehicles.

The BRC Program in Wisconsin

Wisconsin contained many of the better white pine stands in the North-central Region, and interest in protecting white pine was strong within the State among industry, conservation groups, and others. In fact, cooperation throughout the State was so good that the Wisconsin BRC Program was one of the finest—if not *the* finest—in the region. It deserves to be documented here.

Ted Kouba, the Federal blister rust leader of Wisconsin (and a graduate forester), and Ernest L. Chambers, a plant pathologist who was director of the Wisconsin Bureau of Plant Industry, made an excellent team. They not only planned, organized, and implemented the program but also generated statewide support for the work. Chambers' Bureau of Plant Industry also cooperated closely with the Wisconsin Department of Conservation, and this relationship did much to facilitate many actions.

From the very start, Wisconsin was in the forefront in promoting blister rust control. So strong was the support and local interest generated that had there been no Federal assistance, Wisconsin probably would have gone it alone and achieved the same results.

Some excerpts from my recent interview with Ted Kouba, now retired and living in Madison, emphasize some of the reasons for Wisconsin's success:

> I look back on my blister rust days not with nostalgia, but with a great deal of pleasure. We were a young outfit and as energetic as an Arkansas coonhound. We worked hard. Our cooperative program was respected like no other in Wisconsin.
>
> We were in high gear for many years. A total of 460,000 acres of white pine were protected against blister rust by the destruction of almost 100 million *Ribes,* many of them European black currants. We reworked some 300,000 acres and removed another eight million *Ribes.* Many white pines dotting the Wisconsin landscape today are mute evidence of the effectiveness of the Blister Rust Control Program.
>
> When the CCC program was launched, officials requested plans for individual camps. We were ready with plans based on field surveys, not guesses. Blister rust control was allotted the number of men requested. When WPA broke, we were again ready with plans for work in areas not covered by the CCC. Submitted to the appropriate officials, we had Wisconsin's approved Plan No. 1 for that program.
>
> Blister rust control was a cooperative program in the strictest sense. Fourteen counties contributed funds and manpower totaling about a third of a million dollars. And that was big money in those days. Two counties contributed between $5,000 and $10,000 annually for 12 years. Towns, industry, and private individuals made surprising contributions. The Wisconsin Departments of Agriculture and Conservation gave their share. Four Indian Reservations assigned some 116 persons for 12 years to the program.
>
> The Wisconsin Alumni Association of the University of Wisconsin gave generously, as did the Wisconsin Conservation Department in State parks and forests. Pine owners at the Wisconsin Dells assumed an appreciable amount of *Ribes* eradication work in that area.
>
> Throughout the cooperative probram, we did our very best to play fair with all cooperators. We attempted to plan our work, and work our plans. Plans were based on field surveys, not desk estimates. We reported results of our work to all cooperators, something almost unique, and they expressed their appreciation. As a result, we were favored with contributions to continue blister rust control year after year. The superintendent of State parks and conservation was generous in his compliments to the Blister Rust Control Program. During the peak of the Emergency Relief Work programs, some 1,300 people worked at *Ribes* eradication in Wisconsin.
>
> In summation, I would say that extraordinary cooperation was the key to successful Blister Rust Control Program in Wisconsin.

The work in Wisconsin represents an example of why the cooperators stood behind the BRC Program year after year. They were a part of it and it was their program.

Results of *Ribes* Eradication in the North-central Region

During his interview with me Henry Putnam summed up the Blister Rust Control Program like this:

> I am a firm believer that our efforts to protect selected white pine stands in the region were worthwhile. We hit the problem hard, especially during the early years. In those years, we were in a dry period, and as late as the thirties there was a scarcity of white pine reproduction. We typed tens of thousands of acres as white pine planting sites, much of which were later planted to white pine.
>
> The emergency programs were a godsend, for we had many acres mapped and all we needed was lots of labor with strong legs and good eyesight to hike the woods and get out the *Ribes.* These programs supplied the needed manpower.
>
> In the middle thirties, the drought period was replaced by one of plentiful rainfall. This wet cycle lasted some 40 years. During this time, white pine reproduction developed in wholesale amounts. *So did blister rust.*
>
> As years went by and we learned from the work of VanArsdell and other investigators about the importance of climate in affecting the spread and development of blister rust, we criticized ourselves for undertaking control in certain areas. But that was hindsight. In the early years, we went after *Ribes* in all pine stands, not knowing about the high hazard and difficult control task in the northern Lake States

or the almost non-existent rust problem in the southern parts of the region. But I think we demonstrated that white pine can continue as an important tree over much of the region with minimal expense, through adjustments in control practices.

By 1961, initial eradication of *Ribes* had been completed on 85 percent of the control acreage. Some 51 percent was on maintenance and in need of no further work until the trees were cut or the land otherwise disturbed.

The Southern Appalachian Region

For many of the blister rust control years, the southern Appalachians were part of the Northeastern Region. However, there was a period beginning during the end of the Bureau of Plant Industry era and continuing into the Bureau of Entomology and Plant Quarantine regime, particularly during the emergency program years, that the southern Appalachians had regional status. This chapter covers that inbetween period. The States involved were Delaware, Maryland, Virginia, West Virginia, Kentucky, North Carolina, South Carolina, Georgia, and Tennessee.

A Brief History

From 1931 to 1938 the regional office was located in Richmond, Va., and the first regional leader was Roy G. Pierce, formerly one of Detwiler's assistants in the Washington BRC office who had been doing scouting work in the Midwest. Prior to that Pierce had handled information and education activities at the national level.

Information in the records sheds little light on work done during the period Pierce was in charge. Mostly, it consisted of scouting for rust, searching out locations where white pines occurred, and noting the presence or absence of *Ribes* in white pine areas. He consulted with State officials about the blister rust problem, but little if any progress was made toward developing a program. In most of the States in the region, white pine was regarded as a secondary tree species, and little interest or enthusiasm over blister rust could be generated.

In Washington, Martin was becoming dissatisfied with the lack of progress in the southern Appalachians. When he was in California in 1930, observing the experimental *Ribes* eradication work underway there, he became impressed by a young University of California forester, J. Curtis Ball. Ball had spent the summers of 1927, 1928, and 1930, on the California project, and worked full-time there in 1933 and 1934.

Ball was then shifted to the North-central Region, first in a CCC camp near Grand Marais, Minn., on the Superior National Forest. In 1936 he was transferred to the forest supervisor's office in Duluth, under Don Stewart, BRC district leader. He took charge of BRC activities on the Forest and on the Grand Portage, Vermillion, and Cass Lake Indian Reservations. Ball left Minnesota in 1937, due to a cut in BRC funds, for graduate work in forestry at the University of California. During the summer of 1938, he again worked on the BRC Program in California. Late that summer, Martin had Ball transferred to Richmond to work under Pierce. Control area maps had not yet been developed there.

In his recent interview with me, Ball described his experiences in the southern Appalachians:

> Since I was sent to the southern Appalachians mainly to inaugurate a systematic white pine-*Ribes* survey, I developed plans patterned largely after the pine-*Ribes* reconnaissance methods used in California. Roadblocks as used in the Northeast were out because there were few roads...I started with the mile-square grid survey on the old rectangular system in northern Georgia. I learned that the U.S. Forest Service had established new concrete and brass corner markers at every section and quarter section in the Chattahoochee National Forest. This made it easy to tie-in the pine-*Ribes* surveys. From Georgia I worked north. I was amazed to learn that many of the permanent men had never learned to use a staff compass and knew nothing about chaining or using abney hand levels for slope corrections.
>
> After working with the native laborors, who were assisting with the pine-*Ribes* survey, I was also surprised at how quickly they took to the work and how accurate they could pace. Many of 'my mountain boys' could pace across bushy rugged country and hit the section corner marker on the nose one mile away.
>
> In North Carolina, Tennessee, Virginia, West Virginia, and Maryland, it was 'metes and bounds,' so we tied our mile-square grids into established bench marks. In Tennessee, we made good use of the excellent 3½-inch-to-the-mile TVA maps.
>
> Throughout the pine-*Ribes* survey, we ran 16 strips through each 1-mile-square grid. The strips were 300 feet apart. Each was 16.5 feet wide. On the strips, all important tree species were counted and recorded by three diameter classes: 0- to 4-inch reproduction; 5- to 12-inch poles; and 12 inches and over, mature [timber]. Standing dead chestnut trees were also counted. Chestnut was included because in many localities, white pine was taking over old chestnut sites as well as being a component of the so-called white pine-chestnut oak type.
>
> Data were taken on 17 square mile grids which were distributed throughout five States at elevations ranging from 1,200 to 4,570 feet. These elevations represented the minimum and maximum at which pine grow naturally. *Ribes* were recorded by number of bushes and species encountered.
>
> In several remote sections of North Carolina and Tennessee, moonshiners were so numerous we had to employ certain 'key shiners' as crew foremen so we could get our survey work done. One big, strapping fellow we made foreman to give us the green light to work all through the Pigeon River section of Tennessee and North Carolina and into the Great Smokies. . .

Ball, as requested by Martin, drew up a plan, which Martin approved, to reorganize the region, replacing the State leader setup with an area system. Pierce retired soon after, and the regional office was moved from Richmond to Harrisonburg, with Ball in charge. John George was assigned as his administrative assistant. One of the State

leaders became an area leader.

Federal-State Cooperation

Blister rust control work in the Southern Appalachian Region was conducted in cooperation with the States, following the Federal-State cooperative arangements adopted in the Northeastern and North-central regions. The States provided office space, administrative support, other facilities, and some transport, promulgated blister rust quarantines, and outlawed the cultivated black currant on Federal recommendation.

But southern Appalachian States never made any appropriations to blister rust control or allotted much cash from other sources, and citizens were never more than moderately interested in the BRC Program. They went along with it and cooperated more to please the "Feds" than to solve the rust problem.

States of the southern Appalachians faced other forestry problems which they judged more important than the threat of blister rust to a pine species they regarded as only a minor component of their mixed hardwood forests. Nonetheless, they extended a warm welcome and assisted the Federal BRC personnel in every way they could, short of putting up cash.

Results of Pine-*Ribes* Surveys

Ball's surveys disclosed that in nearly 90 percent of the white pine areas there were no *Ribes* and consequently, no blister rust problem. White pine did occur with *Ribes* along the east and west slopes of the Allegheny Mountains in Virginia and West Virginia, but less so further south. In the Great Smoky Mountains of northwestern North Carolina and northeastern Tennessee, and along the Blue Ridge range into northern Georgia, *Ribes* plants were seldom found below 3,000 feet, well above the best white pine stands.

In western Maryland, *Ribes* species were fairly well distributed where white pines grew, between 400 and 2,000 feet. In the Cumberland Mountains of Kentucky and Tennessee, *Ribes* species were found only along a few drainages or in small, isolated patches. In the Blue Ridge Mountains, the bushes were abundant in the north and central sections of Shenandoah National Park in Virginia, but became increasingly scarce further south. White pine extended along the upper slopes and drainages of the Appalachians as well as along the lower slopes and in the Piedmont.

A significant point brought out by this survey was that white pine is a prolific seed producer in the southern Appalachians, and that natural regeneration was successful and increasing. White pine grows rapidly there, reaching largest size in northern Georgia and eastern Tennessee. It grows under a wide variety of conditions in association with many other tree species, and often in almost pure small stands. It has invaded old upland chestnut sites. The white pine weevil, a serious insect pest in the white pine areas of the Northeastern and North Central States, is either absent or a minor problem.

On over 3 million acres of mixed hardwood forests in the southern Appalachians, no *Ribes* exist or the few there have been removed. Of more than 6 million acres examined, only some 600,000 were found to contain *Ribes*. Such areas were mostly in Maryland, Virginia, and West Virginia.

As in other areas of the East where *Pinus strobus* occurs, the cultivated black currant, *Ribes nigrum*, had been planted in some sections, principally around larger communities but only a few compared to other regions. They were soon located and eliminated.

Ribes Eradication on Public Lands

A good bit of *Ribes* eradication work was done on public lands, since these lands were usually located along the mountain chain in sites where Ribes occurred. Work on National Park Service land was done under a cooperative agreement between the U.S. Departments of Agriculture and Interior. Work on National Forest land was based on an informal arrangement between the cooperating parties which, in effect, was a tacit understanding permitting BRC personnel to go ahead on National Forest land as they saw fit, providing work plans were cleared in advance.

The principal rust hazard in the southern Appalachians was along the ridgetops where *Ribes* were plentiful and environmental conditions favorable. Areas for control in National parks and along parkways were selected by Park Service personnel; areas in National Forests were usually selected jointly by Forest Service and BRC personnel. Funding of the work on public lands was based on allotments for BRC made to the USDA and earmarked for use on National Forest or National Park land. The bulk of the control work in the southern Appalachians, as elsewhere, was done during the years of the emergency relief programs.

Aside from the CCC, work camps were not needed and local labor was transported to and from the job in Government trucks. Ample local labor was available, mostly men trained in mountain work, who were well suited to hiking the mountains in search of *Ribes*. They were excellent as blister rust workers.

Results of *Ribes* Eradication in the Southern Appalachians

By the late 1960's, blister rust control had largely fulfilled its role in the southern Appalachians. The region's main contribution to the BRC Program was to show that white pine is more than a secondary species in many sections, and that with encouragement, it could become an important timber tree and perhaps even replace in part the lost American chestnut. White pine not only grows well in sites favorable to it in the South but also is largely free of the weevil plague. Through proper management, white pine could play an important role in the forestry program of the southern Appalachians, a region also largely free of *Ribes*.

Ball requested and was granted early retirement to return to his home State, California. After a short sojourn there he was reinstated to become second in charge of blister rust control in the Northeast. Martin selected John George to replace Ball, and George remained in charge of the southern Appalachian job until the Forest Service took

over responsibility for the program in 1953. The BRC Office in Harrisonburg, Va., was then abolished and the Southern Appalachian Region again became part of the Northeastern Region.

Summary of Work in Eastern White Pine

At this writing, very little new blister rust infection is occurring in the southern Appalachians, the Northeast, or in parts of the North Central States, notably the southern sections of the Lake States and within the scattered plantations and ornamental white pine plantings of Illinois, Iowa, Indiana, and Ohio. The control work done and the knowledge gained about *Ribes* occurrence, pine damage, and the influence of environment on rust activity had succeeded in providing assurance that *Pinus strobus* could and would maintain itself indefinitely as an important component of our eastern forests.

THE BLISTER RUST CONTROL PROGRAM IN THE WESTERN UNITED STATES

The Western White Pine and Sugar Pine Regions

Blister rust control personnel in the Far West were confronted with a situation totally different from that in any other region. New problems came to light while old ones took on new proportions. In the West control of the rust was to become a whole new ball game played by old rules that had to be adjusted, modified, and replaced as work progressed. In short it was "feel your way" from start to finish.

Six species of white pine grow in the western mountains, and most turned out to be just as susceptible to blister rust as did *Pinus strobus*. The two of greatest commercial importance and largest range are western white pine (*Pinus monticola*) and sugar pine (*Pinus lambertiana*). (See figures 11 and 12.) The others are the so-called high-altitude white pines: Limber pine *(Pinus flexilis);* bristlecone pine *(Pinus aristata);* whitebark pine *(Pinus albicaulis*), and foxtail pine (*Pinus balfouriana*). In addition, different species of *Ribes*, which grew in great abundance in places and regenerated prolifically and persistently in newly disturbed sites, had to be dealt with. Some approached *Ribes nigrum* in susceptibility to rust. And they were almost everywhere in many white pine areas.

Much of the white pine grew in rugged areas where roads were sparse or nonexistent, many miles from centers of population. This made the establishment of field camps necessary throughout control areas in the West. Often these camps had to be serviced by pack animals.

The land ownership pattern in western forests was, and is, also different from that in the East. In many sections Federal stewardship is almost predominant. Private land is often intermingled with Federal land. In many places, large blocks of forest lands are owned by big timber companies. And other extensive blocks of timber are owned by the States. This timber ownership pattern enlarged the responsibility and role of the Federal Government in the BRC Program. In contrast to the Northeast, there was no need to "ring doorbells" of many thousands of small owners to seek cooperation. And while some timber companies made direct financial contributions to the BRC program, most worked to get State and Federal appropriations to handle the blister rust problem on private lands.

Finally, almost everywhere that white pine and *Ribes* occur together the environment was, and is, highly favorable to the spread and development of blister rust.

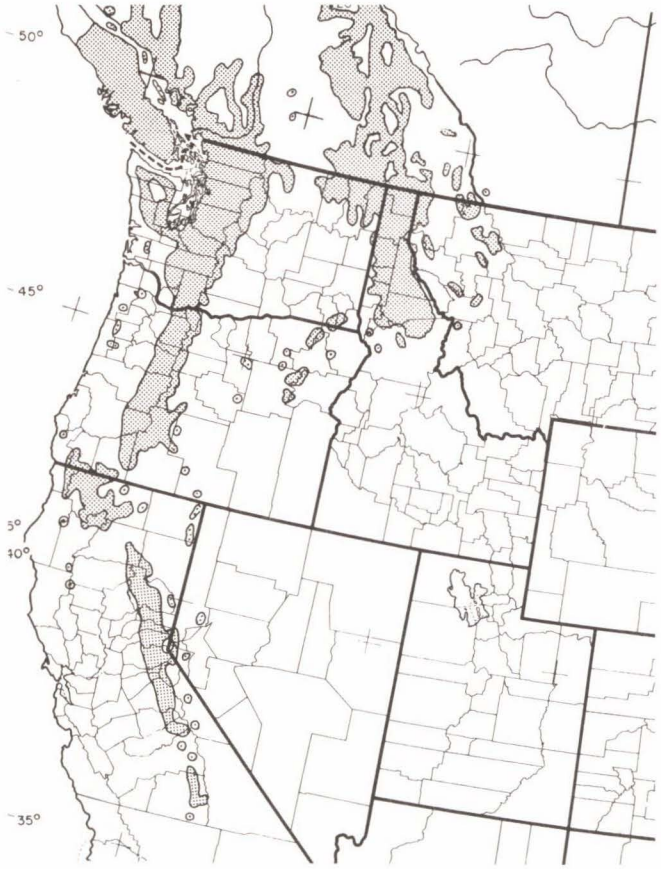

Figure 11.—The natural range of western white pine *(Pinus monticola),* principally the west side of the northern Rockies, and the Cascade and Sierra Nevada ranges of the Pacific Coast region.

(Forest Service photo, F 506624)

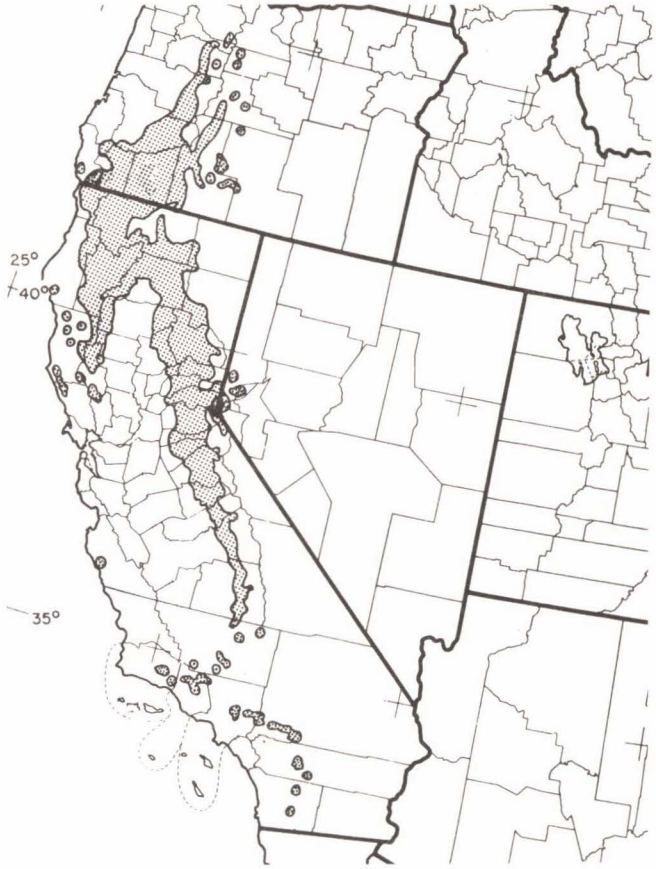

Figure 12.—The natural range of sugar pine *(Pinus lambertiana),* principally the southern Cascades in Oregon and the north Coast and Sierra Nevada ranges in California.

(Forest Service photo, F 506623)

Aside from parts of California, no low hazard areas were identified in the West. Significant variation in hazard did exist, but all hazard was high by eastern standards.

As a result of this combination of factors, control problems in the West were complex and the costs of *Ribes* removal high. More often than not, the problems of camp operation in rugged mountains outstripped the technical problems presented by the rust itself. The prophecy of Detwiler and Metcalf was not far off the mark: control of blister rust under western conditions was going to be exceedingly difficult. In places, the problems proved to be almost insurmountable.

Discovery of Blister Rust in the West

With the rust seemingly contained east of the great plains by quarantines against the shipment of host material, attention in the West focused at first on three activities: Enforcement of Federal quarantines, since this activity held out the only hope of keeping the West free of rust; scouting, as a check of quarantine effectiveness, in the sites where rust was most likely to gain a foothold; and checking nurseries for any evidence of white pine seedlings of foreign origin.

California became the focal point of scouting activity because along both the east and west slopes of the Sierra Nevada, there occurred widely a rust on *Ribes* that scouts were unable to distinguish from blister rust. Scouts who first discovered this rust were uncertain of whether it was blister rust or not, so closely did the infections resemble blister rust. Rusted *Ribes* were first found in Colorado, then in Utah, Arizona, Nevada, and California. Pathologists were baffled until the peridium stage was found on the pinyon nut pines in 1919 (*Pinus edulus* and *P. monophylla*), which grow in the intermountain region. This native pinyon pine rust is now known as *Cronartium occidentale*. Pinyon rust represented no threat to white pines. But it did pose a problem for blister rust scouts.

By 1920, patholigists Ruby Acree and Ann Rathdrum of Dr. Metcalf's staff in the Washington BRC Office had developed a microscopic testing method for distinguishing between the spore stages of the two rusts. At first, only Acree and Rathdrum could do the work. Infected *Ribes* leaves had to be shipped to Washington. Scouts were never certain which rust was present until results came back several weeks later. They also did not know whether factors favorable to one rust in a given site were favorable to the other or not.

Later, when blister rust penetrated California, scouts often found both rusts present in the same locale. Occasionally, both rusts were identified as present on the same *Ribes* plant. There were many complications and much time was spent seeking answers.

With California drawing so much early attention, it was only natural to locate winter quarters there. Berkeley was selected because Region 5 of the Forest Service, the Forest Service's Forest Experiment Station, the University of California, the California office of the USDA Division of Forest Pathology, other Federal agencies, and some large lumber companies all had their headquarters in the San Francisco bay area. Free quarters in Hilgard Hall on the University campus were provided by the School of Agriculture. Blister rust control scouts operated from 1919 through 1920 out of Berkeley, the first western BRC office.

The intitial BRC force consisted of former employees of Dr. Metcalf's Forest Pathology Division of BPI. They came under Detwiler when BRC was separated from the USDA Division of Forest Pathology. Included were: Charles Stillinger, who had been working on quarantine inspection in the Mississippi basin; Leslie Goodding, who had been doing scouting work in Arizona, Utah, and Colorado; and Hiram Johnson, George Root, and Henry N. Putnam, who had been handling the California scouting work. In 1920 Stephen N. Wyckoff, a recent graduate of the School of Agriculture at the University of California, joined the force. He was soon chosen to administer the western Blister Rust Control Program. Gilbert B. Posey, a veteran on Detwiler's staff, had general charge from Washington.

In the short time this force worked out of California, they examined many sites considered favorable to blister rust in California as well as others in Oregon and Washington, all with negative results. Of the many hundreds of infected *Ribes* leaves sent to Washington for rust identification, the word always came back "not blister rust." Most all nurseries in the western U.S. had been double-checked for the presence of white pine seedlings produced abroad. These results were also negative. A belief was growing that the West was clean!

Then in the summer of 1921 the bubble of optimism was shattered. A. T. Davidson, a plant inspector for the Canadian Department of Agriculture, Vancouver, B.C., was examining nurseries for white pine planting stock of foreign origin. At Point Grey near Vancouver he discovered a large plantation of eastern white pine that had come from France as 3-year-old seedlings in 1910. *Ribes nigrum* bushes growing nearby were heavily infected as were native western white pines growing in the vicinity.

Davidson was certain the disease was blister rust. Canadian officials notified Professor Barss of Oregon Agricultural College, who was also head of an ad hoc committee concerned with the rust. Barss notified Gilbert Posey, and they decided to send Henry Putnam to Point Grey. One quick look was all Putnam needed. He telephoned the confirming news — that it was indeed blister rust and that the rust was well established. Eradication was out of the question.

This discovery was only the beginning of the tragic story of blister rust in the West. No other points of introduction of blister rust from abroad were ever found in all the West, Canada, or the States. So from this one spot, rust was to spread by natural means far and wide and ultimately infect all white pine areas of western North America. And the inevitable spread moved at an alarming rate.

Genesis of the Western BRC Program

Detwiler and Posey asked Barss to convene his committee, review the situation from this new angle, and seek opinions on what moves to make. Several meetings were held in quick succession. The principal need was to find out, through concentrated scouting in the Northwest,

how far the rust had already spread. Posey had the Berkeley office moved to Seattle. Scouting got underway at once. Before the year was out, infected *Ribes* and some infected pines were spotted at several locations in northwestern Washington. By midsummer of 1922 rust infections had been discovered at numerous points along the Washington coast from the Columbia River north well into British Columbia and, surprisingly, as far east as Revelstoke in central British Columbia. The discovery at Revelstoke posed a direct threat to Idaho (western) white pine, a scant 100 miles to the south. Conditions for rust spread seemed almost ideal, and cankers on pine were showing up at an alarming rate.

In November 1922 a third meeting of Barss' committee assembled in Portland, Oreg., to review the new evidence of rust spread and to consider a program for dealing with the menace. The unusually large number of participants included representatives from all groups having a stake in the problem: the USDA Forest Service; the National Park Service; the Federal Oregon and California Revested Lands Administration (later taken over by the Bureau of Land Management); four large timber companies; the Western Forestry and Conservation Association; the Western Pine Association; the Washington and Oregon Forest Protection Associations; State Foresters from Washington, Oregon, California, Idaho and Montana; forestry schools in the Western States; State regulatory officials from all the Western States; Nursery associations of the Western Plant Board; British Columbia Departments of Agriculture and Forestry; the USDA Offices of Forest Pathology and Blister Rust Control; and members of the general public.

Detwiler and Dr. J.S. Boyce, head of the USDA Portland branch Office of Forest Pathology, briefed the group on the current situation. Detwiler said, "From all the evidence at hand, blister rust shows unprecedented severity in spread and damage. I have seen nothing like it in the East. Here there are many cankers in each tree that kill all sizes of trees relatively quickly, whereas in the East there are usually but one or two cankers per tree from which trees succumb slowly. Unless something can be done, and soon, the white pines of the Northwest are doomed."

During the 2-day meeting, speakers emphasized the importance of western white pine and sugar pine to the economy of Idaho and California. Industry and governemnt spokesmen were highly vocal about the need to hold on to the white pines, if at all possible. Ralph Edgerton of the Spokane Chamber of Commerce quoted the volume of western white and sugar pine at 57 billion board feet with a market value on the stump of $228.5 million. A representative from California contended that sugar pine was "the most valuable conifer in America and perhaps in all the world." Edgerton and others pointed out that in Idaho, white pine was the bread-and-butter tree of the forest, the only species that could be harvested at a profit under current market conditions. Associated trees were considered "weeds." Lumbering, they stressed, was the backbone of the economy of northern Idaho.

Such was the temper of the meeting. In all likelihood, Detwiler's apprehensions about the possibilities of controlling blister rust in the West were allayed then and there. Ever after, he was a staunch supporter of western control.

A "do nothing" policy was ruled out. Too much was at stake. If any chance of protecting the white pines of the West existed, the consensus was to fight for that chance. Detwiler expressed optimism that protection was possible but the cost would be high. He then outlined the actions to be taken promptly.

First, it was imperative to delay rust spread as much as possible. This could be accomplished by eradicating the cultivated black currant (*Ribes nigrum*) from the West and through rigid enforcement of quarantines.

The Canadian delegates said it was their judgment there was insufficient western white pine in British Columbia, just as was the case for eastern white pine in Ontario and Quebec, to justify a control program. Moreover, the European black currant was a popular plant in the home gardens of Canadians who would object vigorously to its destruction. However, the Canadian authorities in both East and West were always most cooperative, and assisted the U.S. control effort in every way they could.

Second, the disease had to be controlled locally in white pine stands. The time gained by delaying rust spread was to be used to develop methods for eradicating wild *Ribes* and to determine costs.

Finally, an intensive program of scientific research into the life history and habits of blister rust under western conditions would be launched. Studies were to investigate the rate of spread, the rate and extent of damage to western pine species, the susceptibility of western pines and *Ribes* to the rust, natural factors that could hinder spread and, of utmost importance, the distance that infection could be transmitted from *Ribes* to damage pines in the West.

Boyce and Detwiler estimated that at the rate the rust was spreading, they had about 10 years in which to protect selected western pine stands. Hence a 10-year program of control was designed to start off modestly and be enlarged just as rapidly as funds could be provided. The program was to include the recruitment and training of a work force and the development of control methods for eradicating *Ribes*.

The western BRC office was to provide leadership, coordinate the work of all cooperators, and direct control actions. An appropriation of $155,000 in Federal funds was requested to launch the program; however, only $92,000 became available. So with a massive job ahead, the western BRC Program got under way.

The Experimental Era

To implement the resolutions of the Portland meeting, Detwiler, Posey, and Wyckoff of the Office of BRC, and Dr. Boyce, of the Office of Forestry Pathology, moved the

western control headquarters from Seattle to Spokane, in the spring of 1923, to put personnel closer to the action soon to unfold in the Northwest and assigned State leaders to each of the Western States.

Detwiler cited the duties of the State leaders: "Assist with quarantine work, keep track of the spread of the rust within their States, handle black currant eradication, develop and carry out an educational and information program to acquaint the public with the problem, and gain support for actions in dealing with it, and lastly, maintain contact with State agencies and enlist their cooperation."

Research on the blister rust fungus was expanded with Federal funds made available to the Division of Forest Pathology for western work. Dr. Boyce assigned these studies to Harry Lachmund, his principal assistant. British Columbia was the logical place to conduct the studies, since the rust was already widespread there and causing considerable pine damage. The Canadian authorities extended the hand of welcome and were more than helpful in providing air, boat, and some ground transport; some manpower to assist with field work; and the use of their communications network. Beginning in 1923, Lachmund and several assistants spent 6 or more months of each year in Canada for nearly a decade conducting various studies.

Experimental *Ribes* eradication work was to get started in northern Idaho, adjoining the Canadian border. This location was selected in part because it was thought to be representative of the western white pine forest types in Idaho, and in part because removal of *Ribes* along the border might delay rust spread southward. In addition, the location would entail a pack-camp operation over much of the white pine forests in the Northwest. As a corollary, it was hoped that the broad Columbia River that divided Washington and Oregon might stop rust advance southward and keep it out of Oregon and California. The barrier idea lasted only until winds spread spores from the first "wave" of rust great distances.

The States were urged to outlaw *Ribes nigrum* and proceed with its destruction. Following the actions taken in the East, they soon passed anti-*Ribes* legislation and turned the eradication job over to their regulatory units, which promptly passed the buck to the State leaders of the Federal program by deputizing them as State agents. To pay for black currant eradication, the State of Idaho appropriated $5,000 in 1923, thus becoming the first Western State to provide money for blister rust control. The western BRC office began to gather records on the location, volume, age class, and ownership of white pine stands.

Posey and Wyckoff sought seasonal recruits from western forestry schools to enlarge their five-man staff. So began the 1923 field season. Aside from scouting, quarantine work, and black currant eradication (which were being handled by the States), the two field jobs undertaken by the Spokane office were: Establishment of a large study plot in British Columbia which would provide information on the distance that rust could spread from *Ribes* to pine, and operation of a small *Ribes* eradication project in Idaho.

The *Ribes*-to-Pine Spread Plot in British Columbia

Located in the Cheakamus River basin, this experimental plot soon became known as the Cheekye Plot. The plot was laid out by BRC personnel under the supervision of Henry Putnam following a study design worked out by the Office of Forest Pathology. It was circular with a radius of 1,250 feet, about 113 acres. All *Ribes* and native pine were removed from it, and one species of wild *Ribes* known as *Ribes bracteosum* which approached *Ribes nigrum* in rust susceptibility was removed for a distance of 1 mile along all streams, the only site in which this species occurred. Several workings over a span of years were needed to eradicate all *Ribes* from the plot. Next, 3-year-old white pine planting stock was obtained from the Forest Service Savenac nursery at Haugan, Mont. Pines were planted at uniform intervals throughout the plot.

Within a few years, uniform infections on the planted pines in all parts of the plot made it clear that the rust was spreading beyond the 1,250-foot *Ribes*-free zone of the plot. This then-unexplainable phenomenon was to haunt BRC workers throughout Idaho and Oregon; ultimately, it was to defeat them.

Experimental *Ribes* Eradication in Idaho

In consultation with the Forest Service's Northern Forest Experiment Station and the Forest Service's Regional Office, both at Missoula, Mont., the experimental forest in the Kaniksu National Forest near Priest River, Idaho, was selected as the site for the first experimental work. It was more accessible than the Canadian border area. In the first trial, two 5-man crews in 40 days managed to cover 1,700 acres and eradicate 31 *Ribes* per acre on the average. The total cost of this trial was $3,200, or $1.88 per acre. These results were considered encouraging.

A Glimpse of Early Camp Life

By 1924, Wyckoff was ready to expand experimental *Ribes* eradication northward, in the upper Priest River drainage above the town of Priest River, still within the Kaniksu forest. This isolated location was intended to provide information on problems and costs of conducting a camp project serviced by pack animals. Even to reach the area was something of an ordeal. I vividly recall my initiation into BRC duty in June 1925 and my impressions of my new job in the north Idaho forest. In those days, leaving from BRC beadquarters at Spokane, you traveled by train for about 2 hours to the booming lumbering town of Priest River, where you transferred to a freight truck and rode some 25 miles over a dusty road to the southern shore of Priest Lake. Tucked away in the mountains there in the edge of that beautiful lake was the attractive little summer resort town of Coolin, your last contact with civilization for at least 3 months.

From Coolin, the next leg of the journey was by boat — a small freighter. You chugged slowly north, up the length of the big lake, through a "thoroughfare" that connected the big lake with a smaller one, and on across the small lake. There you debarked at a makeshift camp and pack animal-staging area about 30 miles north of Coolin. If you got off to an early start it was nearly dusk when you left the boat. Following a meal at the pack-camp mess, you bedded down for the night under the stars on fir boughs hastily gathered.

When the pack train was loaded, each animal was kept in single file by a short length of rope that extended from the tail of the lead animal to the head of the one following. The packer, mounted on a saddle horse, led the string on a winding path through the forest. At a pace of about 2 miles per hour they carried 1,500 pounds of provisions and equipment to the BRC camps 16 miles to the north.

As soon as you had downed a hasty breakfast of ham and eggs, you loaded your gear in a pack sack, strapped it on your back, and began the last lap of your journey. If you were in fairly good physical condition (something which should have been a job requirement for that location), you could hike along the trail with your pack at about 3 or 4 miles per hour. At this rate you soon overtook and passed the packstring.

Around noon, you arrived at the lower camp, the place that was to be home for the next 3 months. It was what was known as a "rag camp" — that is, a camp of tents instead of wooden structures. In 1924-25, camps on Upper Priest river were representative of all forest camps in the West of that time: they were simple and offered a minimum of human comforts. A 16- by 16-foot Army squad tent served as the cookhouse. A large canvas tarpaulin (or "fly") of about 448 square feet placed across a ridgepole cut from a tree sapling and fastened along each side by ropes and pegs formed the dining hall. Wooden tables and benches hewn from nearby trees made up the dining furniture. Each was responsible for making his own sleeping and living quarters. Usually, two men teamed up to build a two-person lean-to or "wikiup," with a frame of small tree saplings, open in front, and covered by a small canvas fly. Since lanterns were not available, the men made their own lamps by placing a candle in a can as a reflector. These lamps were called "palousers." Beds were made of boughs cut from the closest trees, usually cedar and fir boughs. Bedding consisted of three Government-issue woolen Army blankets. Personal effects were stored in empty wood packing boxes. The boards used to make boxes were the only wood cut by saw in the construction of the camp. All other boards were hewn by adze and splitting froe. And that was about the extent of "improvements" at an early-day BRC camp.

But there was one more item — the "Chic Sale," a shelter in the trees a short distance behind the sleeping area. A canvas fly covered a framework of bracing on which was laid, at the proper height above ground, a peeled sapling about 10 feet long and about 6 inches in diameter. This pole, known as the "slippery elm," was centered above a trench 6 feet deep. And the canvas fly that kept out rain and sun was by no means the only "fly" in the area. Populations were kept low by liberal use of lye. Nonetheless, flies and, worse yet, yellow jackets were a common nuisance.

Since I was to be camp boss at this BRC camp I was to live alone. The acting camp boss, C.C. Strong, a classmate of mine from Oregon Agricultural College (now Oregon State University), was in general charge of the BRC project in 1925. He helped me construct and get settled in my "wikiup." By evening of the first day, I was in business and ready for my first meal. Dinner that night was typical for those days, almost entirely canned. Canned salmon, dubbed "goldfish," was the main entree. Sometimes this dish was served plain; other times, it was laced with eggs and spinach and covered with a cream sauce. On this particular evening it was plain old goldfish. Side dishes included baked beans (known locally as "Idaho strawberries,") boiled potatoes or "murfs", and spinach. Variety depended upon the types of canned foods on hand and the ingenuity and capability of the cook.

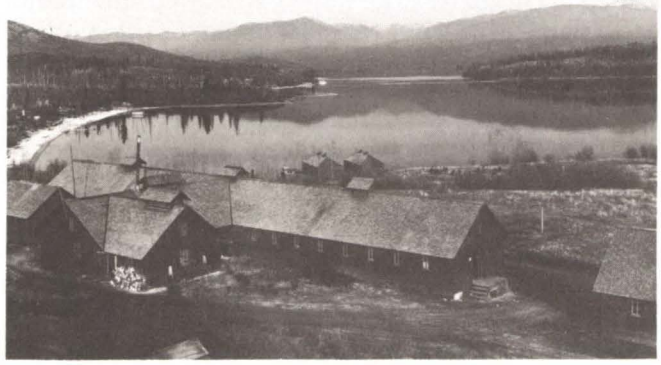

Figure 13.—A blister rust control headquarters camp on Kalispell Bay near Coolin on Priest Lake, Kaniksu National Forest, northern Idaho, in the middle 1920's.

(Photo by USDA Bureau of Plant Industry)

Figure 14.—At the head of navigation on Upper Priest Lake, northern Idaho, in 1925, a team of pack mules was being led to blister rust control camps 16 miles further north on the Kaniksu National Forest.

(Photo by USDA Bureau of Plant Industry)

Breakfasts consisted of ham or bacon and eggs, farina mush, fried potatoes, hotcakes with syrup and butter (butter put up in brine came in cans), canned fruit, and coffee. Lunches were made by the workers and usually consisted of sandwiches made from pancakes (bread was scarce) with canned meat, cheese, or jam. Each man carried his lunch in a sack fastened to his belt so he could eat in the field.

Work Methods of the Blister Rust Camps

Two 30-man camps operated in Upper Priest River during 1924 and 1925. Each camp had a camp boss, cook, flunky, four crew leaders, four five-man crews, and three scouts. The labor force consisted of forestry school students seeking woods experience and the chance to earn some money to continue their education. Saving these earnings was easy. Aside from an occasional poker game for small stakes, there was no way to let summer wages slip through the fingers. Isolation removed all sources of temptation.

Work procedures developed in the East were followed for a while, but modifications were soon necessary. Paper squares proved unsatisfactory as line markers. Two-ply grocer's twine in 2.5-pound spindles was found to be more easily laid out and followed. Wild game soon carried away the many miles of string lanes. Winter snows broke and shattered any remnants.

As in the East most *Ribes* could be pulled by hand. Since there were no roads, working boundaries were often ridgetops and stream bottoms tied into section lines of the public land survey system. Work units were divided into forest types, or associations of trees, where *Ribes* species grew — stream type, open and dense reproduction, open and dense pole stands, open and dense mature stands, and brush. *Ribes* varied in size and number within the different forest types. They were smaller and fewer in the dense tree types than in the open forest types and along streams. Streams posed special problems, particularly in the southern portions of the white pine belt, and special methods for dealing with the *Ribes* along such streams had to be developed.

During the two seasons of work in the Upper Priest River drainage area, crews removed an average of 86 *Ribes* plants per acre at an average cost of $3.50 per acre. Checks made on work quality showed that about 16 *Ribes* per acre were being missed. This was considered not good enough to provide adequate protection. In the East crews reduced *Ribes* to three or four bushes per acre following one working. Smaller crews with workers spaced closer together were tested. After several seasons of experimentationon crews were able to meet a goal of only three or four small bushes missed per acre.

It was on the Upper Priest River project that BRC crews got their "baptism by fire." An agreement between the supervisor of the Kaniksu National Forest and Spokane BRC office stated that blister rust crews would take initital action on all fires within and adjoining the drainage where they were working. Firefighting tools were placed in the camps and men were trained in their use. Many lightning fires hit the area in 1925 and BRC crews spent over half the summer fighting fire. They acquitted themselves well, drew strong praise from the forest supervisor, and set the stage for the major role they were to play as an integral part of the Forest Service firefighting organization.

Forest Service fire plans called for full use of BRC personnel. National Forests in the white pine belt came to rely heavily upon BRC personnel as their first line of defense. Forest supervisors and rangers became staunch supporters of the BRC Program, as did the several forest protection associations responsible for fire control on non-Federal lands.

In 1926 experimental *Ribes* eradication in Idaho shifted to more accessible pine forest types in the Binarch and Lamb Creek drainage areas on the west side of Priest Lake, extending slightly into Washington State. Devastating forest fires swept the area, destroying much of the pine in the control unit, and BRC personnel again spent most of the summer fighting fires.

A project designed to improve methods of eradicating *Ribes* and lowering costs was soon underway in all BRC camps. Various crew sizes, spacing between men, and layouts for covering the work area (whether up and down hill or parallel to the slopes) were tested. Small crews were found to be more efficient, and the three-man crew came into use.

A crew under Henry Putnam began reconnaissance work to map boundaries of white pine forest types and record white pines by sizes; also to record *Ribes* numbers by species and note the density of undergrowth, brush, and other factors affecting *Ribes* eradication work. They ran strips one rod wide by compass and by pacing at quarter-mile intervals, at right angles to watersheds. Costs of this work averaged a bit over 1 cent per acre.

First Work in Oregon

A small experimental *Ribes* eradication project was started in Oregon in 1925. One 25-man camp in Woodruff Meadows, Rogue River National Forest, operated during the summer to gain information on *Ribes* eradication problems in a transition area where both western white pine and sugar pine grew. The average cost of work was $2.44 per acre, somewhat lower than in Idaho.

First Work in California

In 1926 experimental *Ribes* eradication began in California, in the South Fork drainage of the Tuolumne river, Stanislaus National Forest. This was in the heart of the sugar pine forest type. The area contained both uncut and cutover sugar pine.

Keeping Pace With Rapid Rust Spread, 1926–32

By the end of 1926 European black currant eradication was underway in the five Western States where western white pine or sugar pine was of major commercial importance (Montana, Idaho, Washington, Oregon, and California), and BRC reconnaissance was an important ongoing project in Idaho and California. Infected *Ribes* had been found in eastern Washington, northern Idaho, western Montana, and well down the Oregon coast some 170 miles from California. Detwiler said of this rapid spread: "The rust has reached the epidemic stage. If rust control continues at the rate presently programmed, it will result in loss of western white pine on 60 percent of the commercial pine area." The alarming rate of rust spread and Detwiler's forecast of disaster unless control work could be quickly accelerated triggered a special meeting of the Western Blister Rust Conference in Portland in February 1926.

The Conference unanimously agreed that the 10-year program had to be shortened, speeding up all phases. Strongly worded statements requesting share increases in Federal appropriations were sent to the political delegations of the Western States. Officials of public and private lands containing white pine were urged to examine carefully their white pine holdings block by block and decide which blocks of timber merited control and which did not. The conference also urged the Forest Service and large timber companies to undertake studies of growth rates of and potential financial returns from future yields of western white and sugar pine, so that the impact of blister rust control on these areas would be known. Western BRC had a mandate to proceed at an all-out pace.

By 1928 the rust had spread southward in Idaho almost to the limits of the western white pine forest type, southward along the coast of Oregon almost to the California border, and southward about halfway down the Cascade Range in Oregon. Numerous pine infection centers were found, all showing an alarming rate of intensification and damage to pine. Wyckoff recognized from the evidence at Cheekye Plot that 1,250 feet was not an adequate protection zone and ordered a protection strip of 1 mile.

Blister rust personnel were also observing that while some local rust spread and buildup occurred annually, big advances occurred periodically in what they termed "wave years." During these years, wind, fog, and rainfall occurred at periods to coincide with blister rust spore production — aeciospores in early summer to spread infection long distances from pine to *Ribes*, urediniospores during summer to intensify infection on *Ribes*, and sporidia from teliospores produced on *Ribes* in the fall to carry infection to pine. (See figure 1.) When all factors favorable to rust spread and intensification took place at the right time in the cycle of spore production, maximum rust activity occurred. And this happened periodically in the Northwest. The rate of spread slowed down significantly as rust moved into less humid areas to the south. Pine damage during "wave years" was to become almost more than the BRC program could handle.

The degree to which crews were able to eliminate *Ribes*, while adequate to cope with normal periods of rust activity, was not good enough, nor could it be made good enough, to prevent rust infection during a year of peak activity.

Black Currant Eradication

The elimination of *Ribes nigrum* from the premises of western U.S. homeowners, farms, and nurseries was largely accomplished during these years in Montana, Idaho, Washington, Oregon, and California. Compared with the abundance of the cultivated European black currant in the eastern United States and Canada, relatively few plantings existed in the West. Moreover plants were often far from white pine areas. Thus black currant eradication did little to delay rust spread in the West.

Quarantine Work

BRC personnel spent 2 months each spring and fall for several years at key railroad centers, checking for violations of blister rust quarantines during the peak periods when nursery stock was shipped. Many violations were noted. However, quarantines had little effect on the western blister rust situation since the disease was spreading rapidly by natural means. Blister rust quarantines, like the black currant eradication campaign, were carryovers from the East and played little more than an educational role in the western program.

A special quarantine problem arose at the interstate bridge spanning the Columbia River near Vancouver, Wash. Motorists by the score gathered up the red flowering currant, *Ribes sanguineum*, in the spring as they traveled back and forth across the bridge. It was an attractive flowering plant, but its movement across State borders was in violation of State and Federal quarantines. Traffic jams occurred regularly at the bridge until quarantine inspectors gave up a hopeless job.

Development of the *Ribes* Eradication Program

From 1923 to 1932, some 230,000 acres of land were covered by *Ribes* eradication crews in the white pine forest type of northern Idaho, notably on the Kaniksu, St. Joe, Coeur d'Alene, and Clearwater National Forests and on the lands of the Priest Lake, Potlatch, and Clearwater Timber Protective Associations. This work was conducted either as part of the experimental program designed to develop working methods or as actual control operations following this experimental work. *Ribes* plants destroyed averaged 140 per acre and the cost of doing the work averaged $3.45 per acre. A wide variation existed in *Ribes* abundance and removal costs among the different forest

types. However, costs were lowest in dense, mature timber and highest along streams. All in all, groups concerned with the control venture were satisfied the job could be done satisfactorily at a cost not considered prohibitive.

One disturbing element was showing up, however. Eradication crews were consistently missing more *Ribes* than the goal of only four or five small bushes per acre allowed. In some areas, the number of missed bushes exceeded this goal by a wide margin. As one camp foreman with eastern experience expressed it, "We miss more *Ribes* per acre than are pulled by the crews of the East." Quality of crew work would somehow have to be improved.

The *Ribes* eradication program was expanded greatly during the 1928-31 period on National Forest land (the Forest Service operated 8 camps in the Coeur d'Alene, 15 in St. Joe and 20 in Clearwater), and a cooperative program was developed on non-Federal land. The North Idaho Forest Protection Associations made a special assessment of 5 cents per acre to promote control. The State of Idaho began annual appropriations for the work. This cooperation was enlarged as the years went by, continuing over much of the life of the program.

When rust was found in Mt. Rainier National Park in 1927, the National Park Service appealed to the Spokane BRC office for help in assessing the control problem on several pine areas it wanted to protect, if possible. BRC personnel examined the pine units and concluded control was feasible, so the National Park Service authorized the work under BRC direction and *Ribes* eradication went on there for several years. It was to be some time before the insidious nature of the blister rust fungus over much of the Northwest would be properly evaluated by forest pathologists and BRC personnel.

In 1928, Hiram Johnson, BRC State leader in Montana, decided it was time to push for the removal of *Ribes* at the Forest Service's Savenac nursery at Haugan. Large quantities of white pine planting stock were produced at Savenac and shipped throughout the Northwest. Clearly, it was of utmost importance to prevent these pine seedlings from becoming infected. The Forest Service agreed and work began. Little did anyone realize what a monumental job the elimination of *Ribes* would turn out to be in this area. *Ribes* bushes grew in great profusion along the well-watered drainages, and under conditions that made searching them out and removing them exceedingly difficult. Nonetheless, the job was completed to standards thought to be adequate.

It was on the Savenac job that Johnson conceived the idea of permanently ridding the wide streamside bottom lands of *Ribes* by slashing and burning the entire brush cover, and then planting the exposed bare soil to grass. Johnson's long-range hope was to convert a wasteland of brush into a revenue-producing hay field. Much work of this type was done later. But in providing adequate protection against blister rust for the nursery, the venture was unsuccessful. Rust simply could not be stopped by methods at hand.

A modification in *Ribes* eradication procedures, adopted during this period and continued for several years, was to confine *Ribes* eradication to stream-type vegetation and defer work in the uplands until streamside bottom lands had been cleared. This was done because of the way rust was developing in the pine forests. Invariably, infections first occurred in the moist sites along streams. Moreover, the *Ribes* most susceptible to blister rust also grew profusely in stream bottom lands. Thus the theory was that attacking the stream vegetation should serve as a delaying tactic and buy enough time to get the entire job done.

Work by the Forest Service during 1929 and 1930 was done largely along streams. Two special *Ribes* eradication problems were encountered, and highly specialized techniques had to be developed to get the *Ribes* out. The large number of *Ribes* growing along streams, often with their roots under water, and the dense brush prevalent in stream bottom lands, made manual *Ribes* eradication costly and ineffectual. Now the eradication of *Ribes* by chemicals and the use of heavy equipment entered the picture. This called for a special team approach. A new type of control unit was needed.

The Methods Development and Improvement Project

This project began informally in 1926 when Harold R. Offord, a chemistry major from the University of British Columbia, was selected by Wyckoff to solve the most pressing of the stream vegetation problems — how to destroy *Ribes petiolare* (*R. Hudsonianum*, var. *petiolare*) by the application of toxic chemicals. Offord, with seasonal help, began experimental work near Santa and Clarkia, Idaho, on the St. Joe National Forest. Numerous chemicals were tested, and within 2 years Offord had a formula of sodium chlorate in a water solution which would kill more than 99 percent of all *Ribes petiolare*.

The next step was to devise spray equipment for applying the chemical. This job fell to a young mechanical engineer, Frank Breakey. Breakey had contracted a crippling form of arthritis at an early age and could get about only with difficulty. But he never let his physical problem handicap him. Although he moved slowly, he merely planned his day to allow for his slow mobility. He always kept appointments at the agreed time, although this often necessitated several extra hours of travel for him. Breakey was an enthusiastic and energetic engineer with an inventive mind. During his career on blister rust control, he made many contributions to equipment development and improvement. He and Offord modified commercial spraying equipment, both large mobile power units and smaller units that could be strapped on a worker's back. Both types were used extensively — the power units in large areas where *Ribes* was dense and the hand-operated backpack units in less difficult areas.

Due to the decision to go full steam ahead on eradicating *Ribes petiolare*, Breakey and Offord were hard pressed to get the kinks out of the spray methods in time for field use. They almost failed to meet their deadline. Wyckoff,

however, was prepared with a suggestion that was adopted: Because northern winters precluded equipment testing, why not test the equipment along the California coast, where winters were mild?

A drainage area in the Santa Barbara (now Los Padres) National Forest near Morro Bay was selected for the experimental work. A crew from the Spokane office and two trucks loaded with spray hoses, tanks, power units, and miscellaneous gear made the 3-day run and set up winter testing operations. Water was used instead of chemicals. Other than that, the spray technique and layout tested resembled in every way the conditions which would be encountered during the approaching summer's field operations in Idaho. The tests proved successful, and chemical spray equipment was ready for business when the Idaho field season opened. One small problem arose on the California job: most of the Spokane crew contracted poison oak. For some, it was serious.

Now that an effective eradication method had been

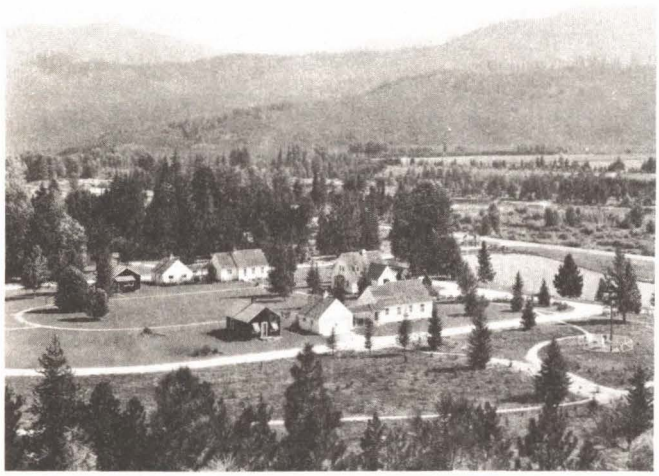

Figure 15.—The Savenac tree nursery of USDA Forest Service near Haugan, Mont., the scene of much *Ribes* eradication work in the late 1920's and early 1930's.

(Forest Service photo, F-410366)

Figure 16.—Early experimental power spraying to eliminate upland *Ribes* on the St. Joe National Forest, northern Idaho, in the late 1920's.

(Photo by USDA Bureau of Plant Industry)

Figure 17.—Hand spraying by backpack of *Ribes petiolare* along streams and lowlands on the Clearwater National Forest, northern Idaho, in the late 1920's. This species was extremely susceptible to blister rust and very hard to eradicate. (Photo by USDA Bureau of Plant Industry)

Figure 18.—Blister rust crew of backpack hand sprayers on the Clearwater National Forest, northern Idaho. Sodium chlorate solution in water was used to eliminate *Ribes petiolare* growing along streams and lowlands. (Photo by USDA Bureau of Plant Industry)

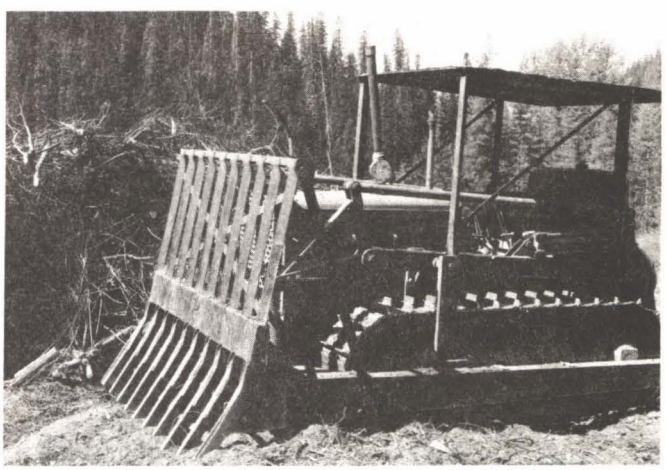

Figure 19.—Specially developed raked-tooth bulldozer, successfully used to convert hundreds of acres of *Ribes*-choked streamsides into valuable grass pasturage during the late 1920's and 1930's. The device saved a great deal of backbreaking hand labor.

(Photo by USDA Bureau of Plant Industry)

worked out for *Ribes petiolare,* the next job was to tackle the stream bottom lands which contained *Ribes inerme* and *Ribes lacustre* concentrations. No chemicals had as yet been found that would do an effective job of destroying these *Ribes* species. Johnson's idea of sweeping the stream bottoms clean by destroying all brush and *Ribes* by mechanical means, and replacing it with other vegetation such a grass, seemed worth trying. Johnson and Breakey went to work on the problem.

The machine selected for uprooting brush and *Ribes* was the road bulldozer. But it had a heavy solid blade that scooped up too much soil. Breakey came up with the idea of replacing the solid blade with a raked-tooth blade, a blade with large heavy teeth that would let the dirt sift between them. When equipped with such a blade, the bulldozer moved back and forth across the stream bottom, uprooting all vegetation in its path. Debris was pushed into windrows. When dry enough the windrows were burned. Later, the cultivated areas were sowed to grass species that would establish a thick, tough sod. Thus treated, formerly economically unproductive, useless brush lands which harbored large numbers of *Ribes* were converted into valuable pasturage. Cost of the work was high, but this was largely offset by the value of the hay. And the procedure eliminated *Ribes* for good; *Ribes* seed could not compete with the dense grass sod.

So during the early stages of what was to become the Methods Development and Improvement Project, two knotty stream vegetation problems were solved and the BRC Program was ready to proceed with eradicating *Ribes* from the western white pine forests of the Northwest. Problems remained, but they could be worked out as they were encountered.

This early work by Offord and Breakey laid the foundation for the Methods Development and Improvement Project (MDIP). It involved a program-oriented research unit which had as its goal the resolution of problems impeding the progress of blister rust control. From a modest beginning as a one-man unit, the project grew with the years to meet growing problems. During peak years, Offord's staff consisted of Virgil D. Moss, Richard T. Bingham, and Frank Breakey in Spokane; and C.R. Quick, Rene d'Urbal, G.R. VanAtta, and L.P. Winslow in Berkeley. Offord and his crew worked closely with research scientists in the USDA Division of Forest Pathology and with scientists at the Universities of Idaho and California. The Methods Development and Improvement unit ran the gamut from laboratory to field: Equipment development and improvement, morphology and ecology of *Ribes*, rust epidemiology, chemical control of *Ribes,* testing of fungicides to control rust on pines and to destroy *Ribes,* and development of resistant pines. Offord's MDIP fostered many innovations in forestry work, and a significant number are still in use.

Pine Damage Surveys

With the rapid buildup of the rust over much of the western white pine belt, it became important to appraise the rust situation for current information on what was happening in the pine stands and to determine how effective *Ribes* eradicaiton work was in retarding pine damage. Beginning in 1928 surveys were carried out over a period of a decade or more. Within a few years data began to show that *Ribes* eradication was not effective enough.

Many members of the Spokane staff worked on this activity from time to time. Two in particular — Herman Swanson and Charles Stillinger — held opposing views of how to interpret disease survey findings. Swanson was convinced that pine infections in control units were the result of *ribes* missed by eradication crews. But Stillinger concluded that while some infection might be attributable to local *Ribes,* the more severe problem was "abnormal spread," the infiltration of rust from *Ribes* outside control units. So certain was Stillinger that his observations were correct that he spent considerable time analyzing infection data to support his conclusions. The more he studied the problem, the more convinced he became that BRC forces were being handicapped by a serious flaw in the basic methods then used to control spread from *Ribes.* He remonstrated with Swanson frequently and vigorously on this point but to no avail. Swanson, backed by the Washington office, would not accept Stillinger's conclusion. Swanson's attitude was influenced by the opinions of Detwiler, Martin, and others familiar with the eastern situation. This group firmly believed in the biological soundness of the 300-yard limit in rust spread as known in the East. Stillinger was later proved correct.

In their survey work, western BRC men had noted considerable variation in the susceptibility of western white pines to blister rust, a variation that ranged all the way from extremely susceptible to extremely resistant. Later, Dick Bingham was to use this information to develop a genetics program in quest of a strain of pine so resistant to the blister rust fungus that it could be safely grown in the presence of *Ribes*. Bingham felt that such a program might result in mass production of rust-resistant planting stock. If successful, this would give BRC a new method for combating the blister rust menace. This project was to become the one enduring promise in an otherwise uphill fight to save western white pine. (See page **42**.)

Return to Upland *Ribes* Eradication

Contrary to expectations and previous testing, the two *Ribes* species in the upland forests, *Ribes viscossisum* and *R. lacustre,* (which grew in the uplands as well as along streams) turned out not to be as resistant as expected. They were only not as highly susceptible as stream bottomland *Ribes* species. But in Idaho, it was becoming clear that the term "relative susceptibility" carried little real meaning. The upland *Ribes* were proving to be bad actors and had to be removed. Consequently, control forces altered strategy again in 1931 to launch a uniform attack on the dual *Ribes* problem, both stream and upland.

Improvements in Camp Facilities

By 1931 BRC camps had come a long way from the primitive forest shelters of 1924–25. Lumber was in wide use, and improvements in sanitary facilities were significant. Assistance from officials of State and Federal public health agencies was sought in developing a camp layout to meet higher sanitary and living standards. When approved, the new design was adopted for all camp units, and the various camp components (such as living quarters, kitchen, messhall, latrines, food storage, office, and first aid station) were made into standardized portable units. These units helped to facilitate the establishment and dismantling of camps in the spring and fall. Portable units were stored over the winter and used again and again.

Results of *Ribes* Ecology Studies Put to Use

BRC personnel had learned from their work with upland *Ribes* species, particularly *Ribes viscossisum,* that alterations in light and temperature, which occurred when a forest stand was logged, caused the long-lived *Ribes* seed stored in the forest litter to germinate. By controlling these changes in light and temperature through modifications in cutting practices, much regeneration of *Ribes* from stored *Ribes* seed could be avoided. The Forest Service adjusted timber cutting practices in white pine forest types as a silvicultural approach to minimizing the *Ribes* problem. The Forest Service also strove for maximum regeneration of pine in BRC areas to help offset *Ribes* eradication cost.

Progress During the Experimental Era

In the Idaho-Montana-Washington ("Inland Empire") western white pine belt, and in Oregon and California, BRC work had progressed smoothly. Eradicating *Ribes* from the commercial white pine forests of the West appeared to be feasible and had wide support.

Then came 1932 and the Depression. Blister rust control was at a low ebb. But rumors were circulating that emergency programs would soon be launched to relieve unemployment.

BRC leaders were ready and much in need of all the labor they could get. They had solved the most perplexing *Ribes* eradication problems, and they had acquired considerable knowledge of the big job to be done. They had gained experience in selecting personnel, training and supervising large numbers of laborers, and inspecting their work and working conditions. They had developed manuals covering all aspects of large camp programs and augmented them with training films and charts. These aids stressed that for control of blister rust to be effective, *Ribes* had to be removed from control areas in a manner which would meet rigid standards, and these standards had to be applied uniformly over extensive areas. To search out and destroy *Ribes* in dense ground cover required the worker to have a mental image of where to look for *Ribes* bushes and a trained eye to find them. *Concentration was a "must".*

BRC leaders had also assembled a tough group of western foresters and trained them in woods work. And they had developed plans for a full-scale *Ribes* eradication program, if and when called for. They had come a long way. Such was the situation at the close of 1932.

The Emergency Program Years, 1933–41

Although all blister rust control work in the West continued to be the responsibility of Wyckoff and the Spokane office until July 1936, the experimental work in Oregon and California was phased out in 1933, with the advent of the emergency programs. After that, control work in those States functioned largely as a separate entity.

The year 1933 was thus a logical time to consider work in the West as two regions: Northern Rocky Mountain—Washington, Idaho, Montana, Wyoming, and Colorado; and Pacific Coast—Oregon and California.

Figure 20.—Small western white pine trees, in foreground, suffer more damage from blister rust than do older trees in background. Young stands like this are often severely depleted or completely lost long before reaching harvest age. (Photo by USDA Bureau of Entomology and Plant Quarantine)

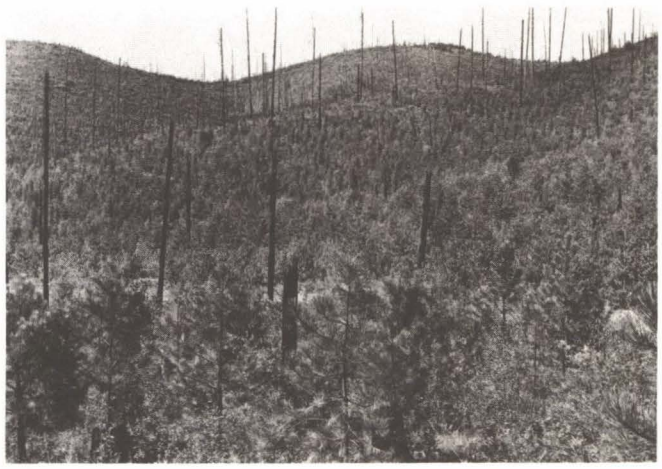

Figure 21.—A burned area in northern Idaho restocked to western white pine. Many *Ribes* bushes usually sprout from seed on the ground in recently burned forest areas. Unless they are removed, the young pines are doomed. (Photo by USDA Bureau of Entomology and Plant Quarantine)

Blister Rust Control Work in the Northern Rocky Mountain Region

This was the region of the big push. Status of rust infections, particularly on western white pine in the so-called Inland Empire centered in northern Idaho, made an all-out attack necessary. And things began to happen early. Detwiler had convinced the leaders of the Forest Service and the Department of the Interior agencies that much of the western CCC work force could be used to eradicate *Ribes*. Here was a golden opportunity to get on with the pine protection job on a scale more commensurate with the need.

Heavy Activity in the Inland Empire

Advance cadres of CCC construction crews landed in the Inland Empire of the Northwest in the spring of 1933, just as soon as trucks could negotiate the roads. The Forest Service and BRC personnel went all out to help locate and build camps. Some 40 camps of 200 men each were assigned to BRC. Although construction and operation of camps was the Army's responsibility, military personnel lacked woods experience and welcomed all the help they could get. By early summer, some 6,000 men from all sections of the country were bounding about the white pine forests, unrolling spindles of twine and lining up five abreast in string lanes to search and pull out *Ribes*.

Then late in August came a second force of *Ribes* pullers. Blister rust control received an allotment of Public Works Administration (PWA) money. The need to get hungry men off the streets into jobs was urgent. Detwiler had told PWA officials that if he got the funds, BRC could put the unemployed to work that fall. He got the money. Camps were set up in record time and soon 2,000 more workers in 60 camps were in the north woods searching out *Ribes*. This added workload taxed BRC personnel to the utmost, for they were wholly responsible for constructing and supplying the Public Works camps, and recruiting the labor force in addition to their supervisory duties with CCC labor. Workers at PWA camps, funded by the National Industrial Recovery Act (NIRA), were kept on the job until snow forced a shutdown in late October.

The year 1934 was an even bigger one. Some 6,200 CCC enrollees were housed in 42 camps. A total of 4,900 men in 146 NIRA–PWA camps in the Idaho woods were working on National Forest land, and 875 men in 30 other NIRA–PWA camps were on cooperative BRC projects on State and private lands in Idaho. In Montana, about 500 men were working in 17 NIRA–PWA camps. Seventy CCC enrollees were pulling *Ribes* in Mt. Rainier National Park in Washington.

Work at about this same tempo continued in the Inland Empire in 1935. Some 7,700 workers were eradicating *Ribes*. By 1936 the CCC program began to taper off, but the public works programs zoomed to 10,500 men.

With such an army of workers living in camps in the northern woods, the matter of health and sanitation received much attention. The U.S. Public Health Service assigned a sanitary engineer, Harry B. Hommon, to inspect BRC camps and make recommendations for improving or maintaining sanitation standards. As a result camps were continually upgraded and made more elaborate. Emphasis on sanitation apparently paid off, for there was a minimum of sickness in the camps.

A special problem in 1936 was a lack of local labor to fill Works Progress Administration (WPA) camp quotas. (PWA had become WPA.) The Spokane area had been milked dry. A caravan of 60 trucks, manned by BRC personnel and escorted by the Idaho Highway Patrol, was dispatched to Boise, Pocatello, and Idaho Falls in southern Idaho to obtain a force of 1,350 laborers for work in the pine forests to the north. One can imagine the impact on small Idaho towns when 60 truckloads of men pulled up for a "rest stop." Town facilities were overwhelmed, and officials were hard pressed to round up the men and get the caravan moving again.

Another 600 men were recruited largely from "skidrow" in the Seattle-Tacoma area of Washington. They were transported to Spokane by special train, and then trucked from there to the camps. BRC spent some $22,000 in 1936 transporting labor. But camps were kept filled and throughout the season full crews were in the string lanes.

To sustain this goal, a camp frequently was involved with two crews at a time: one on the job and one reporting

Figure 22.—This Civilian Conservation Corps camp in northern Idaho was one of many assigned to *Ribes* eradication during the 1930's.
(Photo from the author's collection)

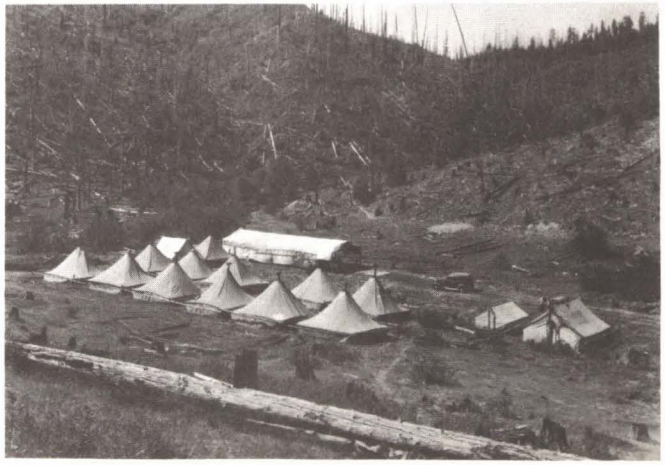

Figure 23.—A CCC "spike" or temporary work camp for *Ribes* control near cutover western white pine in northern Idaho.
(Photo by USDA Bureau of Entomology and Plant Quarantine)

for work. Turnover in this itinerant labor force was high. Such workers were not of the highest social order, so Western BRC faced numerous "people problems."

Once in a while, a drummer would come by a camp peddling cheap wine. When this happened a camp boss might come in from the woods at noon to find his cook and kitchen crew stretched out flat. The boss had to line up a new kitchen crew in time for the evening meal, or pitch in and prepare it himself.

The 1937–40 period was a continuation of 1933–36. The CCC program for BRC was about to end, and the NIRA-WPA emergency programs were also beginning to dwindle. The peak year was 1936.

Pine-*Ribes* Survey Begun in Colorado and Wyoming

A field survey of *Ribes* and the high-altitude white pines (limber, bristlecone, and whitebark) of Colorado and Wyoming was conducted during the summer of 1934 by parties of forestry students led by C. M. Chapman and Ed L. Joy of the BRC staff. They covered National Forests and National Parks. *Ribes* eradication work was done on a small scale in these two States, since *Ribes* was not abundant at the 6,500-to-11,500-foot elevations where these pines grow, and the pines were of only local commercial importance. Chapman and Joy were in charge of this work.

Blister Rust Control Work in the Pacific Coast Region

The experimental phases of the program conducted from 1925 to 1932 ended in 1933, when emergency relief work started. During those 8 years, *Ribes* had been removed from 40,000 acres of sugar pine forest types, and good insight had been gained into the job to be done. No special *Ribes* eradication problems, such as those encountered in the Inland Empire, were noted. Costs were running well below costs there, and checking showed eradication crews were destroying all but four or five small bushes per acre by going one time over the ground.

It was apparent at a glance that *Ribes* in the sugar pine forests were too large and deep rooted to be pulled by hand. Grubbing tools used in the East and Northwest were tested and found too light for the job. Finally, a sturdy tool with a forked claw at one end and a grubbing blade at the other came into use. This tool was the idea of a WPA worker in the Kaniksu National Forest of Idaho. A WPA blacksmith at the Clarkia BRC Headquarters put the finishing touches on it. When introduced in California, it was restyled from a regular mattock and fitted with a standard pick handle. (See figure 26.)

Ribes eradication in the mixed conifer forests of southern Oregon and California was markedly different from that in the Inland Empire. The forests were more open, and much drier. Little or no rain fell from May to mid-September. Summer fog was rare except in Oregon and northern California, where it occasionally formed in the pine belt.

Ribes species in the sugar pine areas were larger and more deeply rooted than those in the western white pine areas. Some areas supported few or none. No *Ribes* species growing in the sugar pine belt approached *Ribes petiolare* or *R. brocteosum* in susceptibility to rust. Sugar pine itself was, perhaps, *more* susceptible, but this was more than offset by the tempering influence of the environment over much of the sugar pine area.

Ribes growth in the sugar pine-western white pine areas of southern Oregon resembled that in Idaho more than that in California. Some 16 species were present in the upper drainage area of the Rogue River, including all species found in Idaho. *Ribes* growth in the sugar pine areas of southern Oregon and northern California varied widely by latitude, exposure, and elevation. In general, the *Ribes* complex fell about midway between that of Idaho and that of the Central Sierras.

Ribes bushes were usually more abundant in the moister sugar pine-fir forest types of the north and east slopes than in the drier sugar pine-ponderosa pine forest types of the south and west slopes. *Ribes* growth along streams, although numerous, was nothing to compare with the concentrations that grew along the wide stream bottomlands in the western white pine forests. The California version of the claw mattock was usually equal to the task of uprooting *Ribes*. Nonetheless, chemicals were widely tested and used

Figure 24.—The kitchen of a blister rust control camp in northern Idaho.
(Photo by USDA Bureau of Entomology and Plant Quarantine)

Figure 25.—WPA laborers just ariving by special train from the Seattle-Tacoma area line up in Spokane, Wash., for transport by truck to the white pine blister rust control camps in northern Idaho, where 10,500 men cleared *Ribes* under the Federal public works program in 1936.
(Photo by USDA Bureau of Entomology and Plant Quarantine)

in areas where *Ribes* were abundant or lodged among rocks where destruction by chemicals could be accomplished at less cost than by hand grubbing.

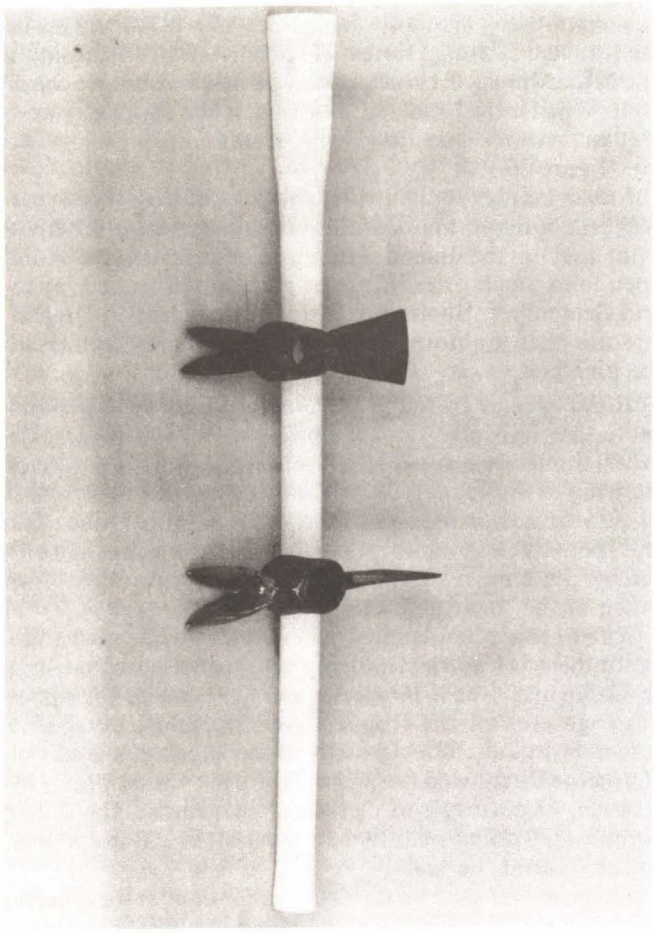

Figure 26.—These variations of the claw mattock were used in southern Oregon and in California to uproot the various large native *Ribes* species. The metal heads are shown separated from the wooden handle.
(Photo by USDA Bureau of Entomology and Plant Quarantine)

While camp operations were necessary it was possible, with one or two exceptions, to locate all camps on roads. Due to the long, rainless season, many small streams flowed intermittently and drinking water was scarce. Workers were forced to carry their daily water rations in canteens.

Considerable logging in sugar pine forests had already been done before 1933, and it progressed rapidly throughout the World War II and postwar years. Moreover, use of the forests for recreation increased. As a result, most of the mixed conifer forests were transected by numerous roads.

Logging and other activity that disturbed the forest soil created ideal germinating conditions for the *Ribes* seed stored by the millions in the forest duff. *Ribes* seedlings came up in great abundance. While most of them soon died, many survived and grew rapidly. Cutover areas were favored sites for the Sierra gooseberry, *Ribes roezli*. It was soon learned that its permanent suppression was going to be a long, drawn-out job calling for several reworkings.

Rattlesnakes were common in sugar pine forest types, and eradication crews carried snake bite kits while at work. Rarely was a man bitten, but the buzzing of a rattler was a frightening sound and always distracted a crew. During the course of their work, the men encountered and killed many snakes. After a kill, they were proud to display the rattlers and often made hatbands of snake hides.

The CCC and PWA Workers Arrive

Such was the state of knowledge of the *Ribes* eradication job when the first CCC workers arrived in the sugar pine forests in the spring of 1933. While the CCC influx caused a sharp upturn in *Ribes* eradication in sugar pine, it was never on the scale of the big Inland Empire program. The same holds true for use of relief labor from other emergency programs. Nonetheless, such labor constituted big business. Quotas of CCC labor for *Ribes* eradication on National Forest lands were used. The National Park Service also relied heavily on the CCC workers to handle the blister rust job in Mt. Lassen Volcano, Yosemite, and Sequoia-Kings Canyon National Parks in California, and Crater Lake National Park and Oregon Caves National Monument in Oregon.

As elsewhere, the Forest Service and National Park Service looked to BRC to supervise and direct the field program. Members of the BRC staff were assigned to all National Forests and Parks conducting a blister rust control operation. At the regional level, the Forest Service and National Park Service assigned representatives to handle their parts of the job. When the Bureau of Land Management began blister rust work in Oregon, it too assigned a representative.

Just as in the other regions the BRC Program in Oregon and California received its first allotment of Public Works Administration funds in late summer of 1933. The go-ahead to commence work came late in August. The small BRC staff in the Pacific Coast Region at the time more than had its hands full. In 1933 there was no year-round office or any office staff to handle payrolls and administrative work. I was in charge of *Ribes* eradication, reconnaissance, and checking for California then.

In late August I received a telephone call from Steve Wyckoff that went something like this:

> Hi, Bennie. This is Steve. We got our money, and it is imperative that we line up relief labor and put them to work this fall. I realize it's late in the season, but don't let that bother you. Your quota is 500 men in California, and Wessela will get another 100 men in Oregon. Detwiler promised that if we got the money we would have camps operating in 10 days.
>
> I'm asking Region 1 of the Forest Service to send you the needed camp equipment from their supply depot. You should receive it at Sonora, Calif., in a few days. I am also sending you an experienced clerk to handle payrolls and vouchers, plus a clerk-steno. They'll arrive in Sonora within a few days too.
>
> The rest is up to you. You are authorized to shortcut normal bidding procedures to expedite procurement of supplies locally. You are expected to contact and work with the State Director of Emergency Programs. He's located in Sacramento. You are now on your own. Get going and God bless you.

That was quite an order! By the next day, things began to move. For the California portion, it was decided to concentrate the work on the Stanislaus National Forest and direct field operations from a temporary office in Sonora where

the supervisor's headquarters for the Stanislaus was located. I contacted the forest supervisor and the Regional Forester, S. Bevier Show, who gave their blessing to what we were about to do, with these words from Show: "OK by me, but I think going ahead at this late date to establish camps in the Sierras is about the wildest dream I can imagine—remember the Donner Party!"

The BRC field leaders located campsites on the Stanislaus in cutover areas where *Ribes* populations were heavy enough to be readily identifiable even after leaves were cast. And leaf drop comes early in California because of the long, hot, dry summers. We obtained lumber for camp use locally after getting oral price quotations. We obtained trucks from General Motors and Ford assembly plants in the San Francisco Bay area. The low bidder delivered the trucks on the main street of Sonora around midnight. Groceries and miscellaneous supplies were obtained via bids given by local hardware and grocery stores. By the time an express car filled with camp gear reached town, camp layouts were complete and the framework for camp components was in place.

An ample labor supply was available at Sonora and in other nearby foothill towns. Many skilled woodsmenwere out of work and itching for a chance to to after the *Ribes*. The labor force was recruited and cleared later with the State Director of Emergency Relief Programs, who was also just getting set up to do business. Within the designated 10 days, three camps on the northern end of the Stanislaus and four in the central section were in operation and fully manned.

In the meantime, Connie Wessela went through a similarly hectic ordeal. As he remembers it, the situation unfolded something like this: "I was working as foreman in a BRC camp on St. Joe National Forest, northern Idaho. Wyckoff's telephone call reached me around three in the afternoon. 'Report to Spokane as fast as you can get here. A truck loaded with camp gear awaits you. You are to move out at once for Medford, Oregon. Upon your arrival, contact the Forest Supervisor. He knows of your assignment. Then, be off and get your camps set up.'"

Wessela located his camps on Rogue River National Forest near Union Creek, Oreg., along the Crater Lake Highway. He also had them manned and operating within the time limit set. It took many hours of overtime work to meet the deadline. Camps were able to operate well into November before winter snows forced closings.

In November the California BRC contingent went to new winter quarters at Government Island in Alameda. Wessela returned to the Spokane office after storing his camp equipment in Medford.

By 1934 eradication of the cultivated black currant in California and Oregon had been completed. Intensive scouting had failed to turn up any rust on *Ribes* in California. However, a well-established infection center was discovered in the Panther Creek drainage of the Siskiyou National Forest in southern Oregon, just above the California border. Sugar pine of all ages in the infection area was already severely damaged by the rust at the time of discovery. This infection center represented a good demonstration of the damage blister rust could inflict on sugar pine, and many California lumbermen and foresters visited it for a firsthand look at the problem facing them to the south.

A BRC reconnaissance survey had been completed on several National Forests in California. These surveys provided good insight into the pine and *Ribes* situation and into problems to be encountered in eradicating the *Ribes*. More information on distribution and amount of sugar pine in California was secured by the cooperation of lumber companies who gave permission to use their timber cruise data. In 1932 we examined all records, both public and private, to obtain information on sugar pine occurrence by land ownership. Sugar pine figures were recorded on township plats on which sections were subdivided into 40-acre squares. Sugar pine forest type was considered to contain 3,000 or more board feet per acre. Volume of sugar pine, obtained from cruise sheets, was indicated for each 40-acre block. The principal tree species associated with sugar pine, such as Douglas-fir and white fir, incense cedar and ponderosa pine, were also recorded. From these data, it was possible with fair accuracy to outline on a map sugar pine distribution and abundance by type and land ownership. When completed, this rapid and inexpensive survey gave a good picture of the location and amount of sugar pine throughout the State. The information was a big help in developing plans for the BRC job.

By 1934 *Ribes* eradication had reached fairly large proportions. In addition to work by CCC laborers from a dozen camps, 34 NIRA-PWA camps with 1,200 men were operating in California. Late in 1935, the WPA program got under way with relief labor recruited from the cities.

As elsewhere, 1936 was the peak year of the emergency programs with over 3,000 WPA workers and around 1,200 CCC workers in California and some 300 WPA laborers in Oregon.

In 1936 blister rust infections were first discovered in northern California, in the East Fork of Indian Creek, Klamath National Forest, and in Monumental Valley of the Siskiyou (now Six Rivers) National Forest. Infections reached as far south as Trinity and Lassen Forests in California by the fall of 1938. Infected *Ribes* were abundant throughout southern Oregon and on the Klamath. The CCC program was winding down by 1937. Other emergency programs continued for another 3 years at about 1936 levels.

The year 1940 saw the end of 8 years of control work with emergency relief funds in the sugar pine forest type. Some 830,000 acres of 2.5 million acres then in control units had been covered by first-time *Ribes* eradications. Rework had been done on 300,000 acres. The average cost of this work was $3.18 per acre.

California Becomes Largest Contributor

Work was curtailed sharply in 1941. The Lea Act (see Appendix IV) was now the guiding light of BRC, and it called for matching funds from cooperators. The State of California was quick to respond with $50,000 for State and private lands. Within a few years, the State appropriation reached $170,000 annually, making California the largest State contributer to the program. State funds were turned over to be expended as a special cooperative account.

The Post-Emergency Program Era, 1941-65

The Northern Rocky Mountain Region

With the onset of World War II emergency programs were terminated and blister rust control entered a period of austerity for the duration of the war. This affected the program nationwide. Its impact was particularly harsh in the Inland Empire portion of the Northwest where so much had been accomplished under the emergency work relief programs. Rework was overdue, and reworking schedules could not be maintained. To compound the problem, the sharply accelerated program of logging in the white pine areas added thousands of acres of cutover land to the rework category. And to cap it all, 1941 was a "wave year" for the rust, one of the worst. Infection spread for long distances, and much of it got into white pine in control areas.

The Washington, D.C., BRC Office was mindful of the plight in the Northwest and "pulled out all stops" to find a labor force. War prisoners, Mexican nationals, high school boys, and delinquent youths were all drawn upon to speed up rework. The BRC staff did all within its power to mold this heterogeneous work force into an efficient *Ribes* eradication crew. At best, it was a makeshift outfit. Only the highest priority white pine areas were able to get attention, and accomplishments there did not measure up to the rigid *Ribes* suppression standards then in effect. This combination of adverse factors dealt a crippling blow to the program, a blow from which it never fully recovered. BRC, Forest Service, and industry personnel had to re-examine white pine areas, eliminating many thousands of acres from the control program.

When World War II was over, increases in regular appropriations under the Lea Act injected a new breath of life into the program. The Act had been tailored by western groups to fit western conditions of large Federal ownership and much intermingling with non-Federal land.

The control program was able to move forward once again. The State of Idaho and the timber protection associations increased their contributions in support of control on non-Federal lands to meet the matching requirements of the Lea Act.

With this renewed impetus, two problems that had been tabled during the war years had to be met head on—far too much infection was occurring within areas from which *Ribes* had been eradicated, and the cost of eradicating *Ribes* was getting out of hand. These two problems were interrelated. To find and remove the first *Ribes* cost little; to find and remove the last *Ribes* in a pine stand cost a lot. Yet, if control were to be successful, the rust had to be stopped. Blister rust control was paying a stiff price for those banner years of the emergency programs when the big push was to cover as much ground and eradicate as many *Ribes* as possible in the shortest time. The standard operating procedure had been to move rapidly and get out as many *Ribes* as possible while the big labor force was available. Clean-up could be done LATER—following the war...now "later" had arrived. And no one could have foreseen the impact of the 1941 wave year.

Forest Service leaders were becoming worried about these problems, particularly the problem of economics, and were beginning to wonder about the rising spiral of costs. Don Matthews and Blair Hutchison, Forest Service economists, were assigned the tasks of assessing BRC accomplishments in the white pine belt of the Inland Empire and of developing a control policy for the National Forests. Their study, completed in 1948, was directed toward answering three questions:

1. Can blister rust be controlled?
2. If so, can it be controlled at reasonable cost?
3. Are future white pine values worth the expenditure?

To the first question, the answer was a "yes", providing *Ribes* were suppressed according to the rigid standards set and held at those low levels by properly timed reworkings. The second question was also answered in the affirmative. A balanced, long-term blister rust control and pine management program was justified from a public point of view, which attached as great or greater importance to social gains as to direct financial returns. And to the third question, the authors said, "It is desirable to forge ahead with blister rust control due to the regional and national public values involved."

The Matthews-Hutchison report became Forest Service policy for the Northern Rocky Mountain Region and BRC went forward with increased enthusiasm, hitting hard at the big job of rework. *Ribes* suppression standards were lowered to 5 feet of live stem per acre. While this figure was not always attained, it was approximated. Understandably, the costs were high. In 1953 Herman Swanson became Assistant Regional Forester for blister rust control in the Forest Service's Northern Region headquartered in Missoula, Mont. Just about the time real progress was being made in cleaning up the highest priority pine lands from which *Ribes* had been removed initially, another problem raised its ugly head. An accelerated program of disease surveys was turning up a pattern of infection within control areas that hinted strongly of abnormal spread of rust from *Ribes* beyond a mile, tending to confirm Roy Stillinger's hypothesis. The impact of the 1941 wave year prompted BRC personnel to undertake studies of weather conditions in an effort to ascertain what had happened. Weather records disclosed that for 18 days, throughout the forests of the Inland Empire during August and September, the relative humidity reached 95 percent in a temperature range of 55 to 65 degrees F. This represented almost ideal conditions for rust development and painted a grim picture of the rust potential. Nonetheless, studies of rust damage also showed two positive trends: infection did not necessarily constitute damage, and occasionally trees remained free of rust in severe infection conditions. A high percentage of branch cankers died before causing any damage (up to 90 percent) and often young replacement pine filled in behind trees that succumbed to the rust. While the impact of wave years was serious, the consensus was that the situation was not hopeless.

The Pacific Coast Region

During the war years blister rust control was on a small scale. Emphasis was placed on rework in an effort to keep *Ribes* populations under control on the large acreage covered during the emergency relief program years. Labor was hard to come by and much of it was of poor quality. However, convict labor, provided by California prison authori-

ties, was made available and used extensively with good results. As elsewhere, costs began to climb sharply.

By 1943 rust had spread southward to the Mendocino National Forest in the Coast Range, and to the Eldorado National Forest in the central Sierras. Following the war's end, funds for blister rust control were once again increased, and work was resumed on a substantial scale. In 1946 the Forest Service was operating 20 camps with 1,000 workers. The National Park Service was operating 7 camps with 350 workers, the Bureau of Land Management had 3 camps with 200 workers, and the USDA Bureau of Entomology and Plant Quarantine (EPQ) operated 17 cooperative camps on State and private land. Cost of eradicating *Ribes* continued its sharp rise, so much so that BRC leaders were becoming worried.

Spiraling postwar costs stimulated blister rust leaders to give special attention to cost-cutting measures. Two new procedures for eradicating *Ribes* evolved—both the ideas of Conrad Wessela. One procedure was to contract the work, which eliminated all supporting expenses of a camp operation and generated competition that might drive costs down further. The other was the adoption of a one-man crew to replace the normal three- to five-man crews used in BRC camps. With a one-man crew, responsibility for production and efficiency could be pinpointed. Both resulted in substantial reductions in costs.

Work by Contract

For a contract program to work, two requirements had to be met—a reservoir of skilled workers experienced in *Ribes* eradication work had to be available, and the Federal Government (Blister Rust Control) had to have a sufficiently reliable and experienced checking force to approve or disapprove work done by contractors. Both requirements could be met.

The checking project of the Pacific Coast Region was a comprehensive one operated independently of *Ribes* eradication. And the California and Oregon projects had employed many college students and experienced woodsmen on *Ribes* eradication who were eager to tackle a contract job on a competitive basis.

Several trial runs at contracting showed excellent results. Costs were running from one-third to one-half less than force-account work. So work by this method was pushed. Within a few years, contracts accounted for most of the *Ribes* eradication job, and the need for camps dwindled. Near the end of the program, work by contract had replaced force account almost entirely. Even some of the checking work was done by contract with good results.

One problem arose that was quickly detected and corrected. The contractors were overusing the Federal Government checking force to help them meet contract requirements. They would run through an area hurriedly and then call for repeated checks, which ran up checking costs. BRC soon closed the door on this practice by allowing one "free" check. Any subsequent requests had to be at the expense of the contractor.

Contract work was also used extensively in the North Central States. The East never felt a need for it, as *Ribes* suppression was far along by the time contracting came into use. It was tried in the Inland Empire also, but for some reason contracting never caught on in the western white pine forest type.

The One-man Crew

With this method a man worked alone only in the sense that he was alone in his assigned string lane. Other one-man "crews" in adjoining lanes worked nearby. String lanes, put up in advance, were numbered so each man knew his individual performance could be checked. Accomplishments by this method usually resulted in a faster and cleaner job of *Ribes* eradication, with a resultant lowering of costs. This method was widely used in both the Pacific Coast Region and the Inland Empire.

The Economic Pinch

In spite of these improvements the cost of eradicating *Ribes* continued to rise, due to a general rise in costs and wages. Savings in methods of doing the work could not keep pace with the cost spiral. And to this was added the ever-increasing acreage of cutover land with the consequent upsurge in *Ribes*. Work on *Ribes* ecology gave a clear picture of what to expect in *Ribes* comeback following any soil disturbance. And the story spelled trouble—trouble in the form of repeated reworkings on proper time schedules. Only work at the right time would break the cycle of *Ribes* re-germination. And the time interval for rework was 3 to 4 years.

Confronted with some 2.5 million acres of sugar pine type, BRC personnel in the Pacific Coast Region knew something had to give. Over much of this acreage sugar pine, although meeting forest type standards, was secondary in abundance to associated species. And unlike western white pine, which usually reproduced prolifically following cutting, sugar pine reproduced sparingly in many areas in comparison with fir, cedar, or ponderosa pine. A downward adjustment in acreage seemed in order.

Following discussions with the Forest Service in 1949, it was decided to examine the BRC-sugar pine situation through an in-depth economic study. Dr. Henry Vaux, forest economist of the University of California School of Forestry, agreed to undertake the project. BRC was to assist by making available all its supporting data on *Ribes* eradication costs in different types and estimated total costs of permanently suppressing *Ribes*.

The completed Vaux study outlined the economic criteria to be met before *Ribes* eradication would pay. And these criteria called for integration of BRC with a timber management program aimed at obtaining maximum stocking of sugar pine. The sugar pine types were carefully examined using the Vaux economic formula as a guide. Only some 618,000 acres of the best sugar pine met the formula.

These 618,000 acres consisted of many units of varying size scattered up and down the Sierra and Cascade ranges. This brought into sharp focus the matter of the needed protection zones around each unit. It called for local control of blister rust in the fullest sense. The width of these zones would influence greatly the actual acreage on which *Ribes* had to be eradicated and thus the control cost.

By the late 1940's it was apparent that spread of blister rust southward was much slower than in the north. Also, infection centers were scattered and largely confined to

sites where dew and other moisture was most prevalent. On the evidence at hand, the rust was being sharply retarded by natural factors. The long, hot California dry season was turning out to be a significant assist to the control program. Even wave years had lost much of their sting if, indeed, there were wave years in the sense that they prevailed further north. Studies on rust spread in California conducted by Dr. Willis Wagner of Forest Pathology confirmed the highly local spread and slow development of infection, and its slow invasion into upland types from points of origin along meadows, streams, and other moist sites.

As a result, blister control leaders felt safe in affixing buffer strips 300 to 600 feet in the higher hazard areas in northern California, and 30 to 300 feet wide in the medium hazard areas of the central Sierras.

Ribes suppression standards were also adjusted. They were set at 15 feet of live stem per acre for high hazard areas and 30 feet of live stem for medium hazard areas. No eradication was to be done in low hazard areas. BRC work was conducted on this basis from the 1950's into the 1970's, when *Ribes* eradication ceased due to high costs. By 1976 the rust had reached southern California on the Sequoia National Forest, but aside from the small moist sites where it gained a toehold, blister rust was showing little tendency to spread from those scattered small sites into the upland types.

Two Special Projects of the Northern Rocky Mountain Region

Blister rust leaders knew the rust made long distance jumps during favorable "wave years." And they knew that current control could not be made leak-proof. However they believed that "wave year" activity would not occur often enough or over a wide enough area to cause a breakdown in the biologically sound concept on which control was based. They had concluded that they could live with the "wave year" impact if *Ribes* was kept at low levels in control units. During the post-emergency program years, however, they began to have second thoughts. Also, they were beginning to realize that *Ribes* regeneration on cutover lands was going to be more persistent and costly to contend with than originally estimated. So the job of holding *Ribes* at low levels in cutover areas was going to be difficult. The economic pinch was tightening. If the protection zone had to be made wider, how much wider? If sporidia from *Ribes* could negotiate a mile path through the Idaho sky and remain viable to infect pine, then why not 2 miles or more? No one had an answer then and no one has an answer to this day.

With the economic crunch already putting program funds in jeopardy, BRC leaders knew the traffic would not bear any enlargement of the protection zone even if they knew the amount of enlargement that would solve the problem. They had to face the hard fact that the economic burden of getting out and keeping out *Ribes* had become too costly.

In such a spot, it was only natural to seek other means to cope with the rust. Two possible solutions had been in the testing stage for several years and preliminary results looked promising. One was a direct attack on the rust itself with antibiotic fungicides. The other was to breed rust-resistant strains of pine through genetic manipulation. The former held the potential of a quick solution. The latter, by its very nature, was a long-range project.

Experiments With Antibiotic Fungicides

The first ray of hope that a chemical formula might be concocted to kill the blister rust fungus in a tree without damaging the tree came in 1949 when the antibiotic cycloheximide (Actidion) was tested by Virgil Moss of the BRC Development and Improvement Project. Test results looked good and many more favorable tests were conducted by Moss. In 1957 cyclo-heximide was used operationally. The fungicide was applied to the basal stem of blister rust-infected pines. Work of this type was carried on until 1965.

In 1958 a second antibiotic, Phytoactin, showed promise as a foliar needle spray. Foliar tests by helicopter were started in 1959. Here again test results looked good. BRC leaders were uneasy about the lack of additional testing by other scientists to provide breadth and depth to Moss's test results. Moss himself realized his tests were not ready for operational use and was anxious for other investigators to enter the field. But no other investigators were then working with these fungicides on white pine, and time was critical. Tens of thousands of white pine trees were succumbing to blister rust each year, in spite of the most carefully conducted *Ribes* eradication campaigns. Regional Forester Tebbe of the Northern Rocky Mountain Region (1) of Forest Service passed the word: "We are taking a long-shot gamble, but let's go operational with aerially applied Phytoactin." This was in 1961.

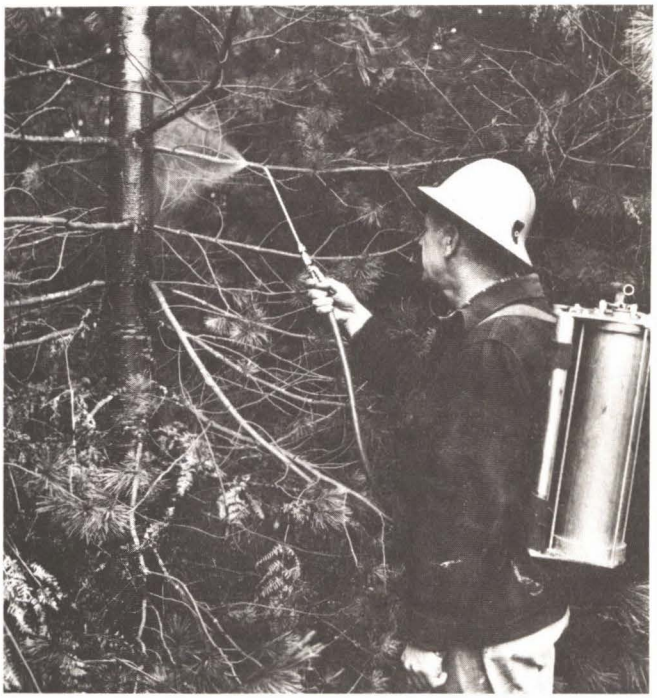

Figure 27.—Use of antibiotic fungicides against blister rust on a full-scale basis began in the West in 1957 with Actidion (cycloheximide). It was sprayed on the trunk of infected trees. Although promising at first, later assessments indicated its value questionable, and its use was sharply limited after 1965. This photo was taken in 1960 in a western white pine stand on the Coeur d'Alene National Forest in northern Idaho.

(Forest Service photo, F 514350)

Applications of Phytoactin by helicopter (at the rate of a quarter of a pound per acre in water solution) went forward on an expanding scale and continued through 1965. Well over half a million acres of white pine in the West were treated with aerially sprayed Phytoactin and some 1.5 million infected pines were hand-treated by applying cycloheximide to the trunk. During 1961–65, Region 1 phased out *Ribes* eradication. BRC personnel of the Inland Empire were enthusiastic over their chances for overcoming the one remaining obstacle to success. They were optimistic that they had, at long last, discovered the tools for winning the war against blister rust.

They developed what they thought would become an effective integrated control program: (1) Control by *Ribes* eradication on selected white pine stands under 10 years of age; (2) control by applying fungicides on stands older than 10 years; (3) immunization of nursery stock by dipping seedlings in a solution of antibiotic chemicals, and (4) development and mass production of planting stock resistant to blister rust.

This integrated program presented a rosy picture, but aside from the development of resistant nursery stock it was mostly on paper. By 1965 results of tests with antibiotic fungicides by other investigators began to come in: Tests on sugar pine, eastern white pine, whitebark pine, and limber pine were largely negative. Results of tests on other tree fungi also were negative, and results of antibiotics on western white pine in parts of the range outside the Inland Empire were erratic. It was time for the Inland Empire group to take a hard second look at their results. What they learned astonished them. About half the blister rust cankers in any stand were being arrested by *natural* factors! The purple mold fungus, *Tuberculina maxima* (a known parasite of blister rust fungus, although generally considered by pathologists as weak), had mushroomed rapidly along with the expansion of blister rust infections, further accounting for canker deactivation. And some cankers classed as arrested following cycloheximide treatments were showing signs of life.

These factors imposed a masking effect on the true picture, and antibiotics were being given credit for doing more of a job than was actually the case. Also there was undoubtedly some wishful thinking. The rust control situation had become desperate in the Inland Empire, and it is hardly surprising that some distorted conclusions came from viewing results through "rose-colored glasses." The antibiotic operation, like *Ribes* eradication, had failed to do a good enough job of stopping blister rust. In 1966 all further uses of Phytoactin were suspended, and use of cycloheximide was limited to small acreage of selected pines.

Following this action, the Inland Empire BRC staff and Forest Service Region 1 officials made a careful assessment of the situation. While it might be possible to live with the damage resulting from "wave years," provided *Ribes* were kept suppressed to very low levels, the costs of such intensive work and needed rework had become prohibitive. To dampen the picture further, white pine—once the bread-and-butter tree of the north woods—although still the most valuable was no longer the sole money maker. Associated species, once considered weed trees, had come into their own. The differential in value between white pine and Douglas-fir, white fir, larch, and cedar was shrinking. Forestry officials had little choice. In

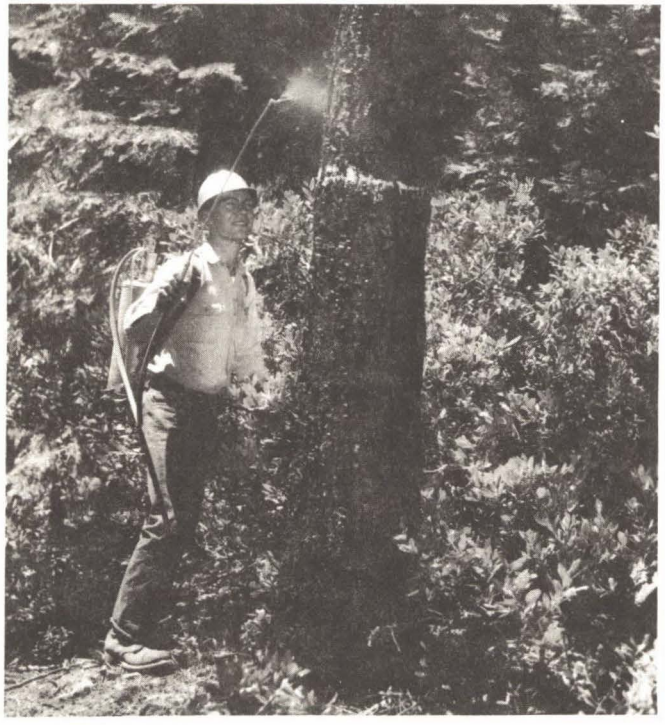

Figure 28.—Hand spraying the antibiotic fungicide cycloheximide to the bark of a mature sugar pine on the Shasta National Forest, northern California, in 1961. Its effectiveness proved to be limited, and it was discontinued a few years later.

(Forest Service photo, F 499301)

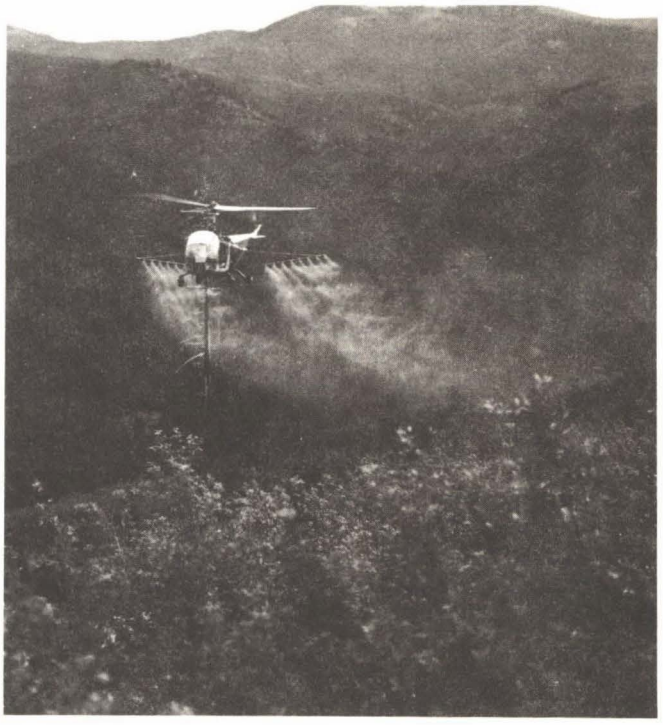

Figure 29.—A second antibiotic, Phytoactin, also showed much promise against blister rust when sprayed on the foliage of infected white pines in the West. However, its effectiveness also came into question, and its use was suspended in 1966. Here it is shown being sprayed by helicopter on a National Forest in northern Idaho about 1961.

(Photo by USDA Bureau of Entomology and Plant Quarantine)

1967, blister rust control in the Northern Rocky Mountain Region officially came to an end.

The Genetics Project

Unlike American chestnut trees, all of which appeared to be equally susceptible to the foreign blight, and were consequently wiped out, white pines show a wide variation in susceptibility to blister rust. A few individual pine trees are exceedingly resistant—so much so that they are virtually immune to rust damage. This is true no matter how severe or prolonged their exposure to infection. There have been no known instances in which all pines in an infection center have been killed. While the percentage of resistant trees in any stand is very low, a number of them are always scattered among their susceptible associates. This seems to hold true for all species of white pine. The factor responsible for this resistance appears to be genetic, a matter of gene arrangement within the tree cells. Richard T. Bingham, who was on Harold Offord's Methods Development and Improvement unit, was assigned to the blister rust genetics resistance project. Dick attributes the scientific basis of the blister rust genetic resistance work with western white pine, and ultimately its success, to the fact that it was a cooperative program. Said Bingham, in reviewing its beginning, "We had the knowledge of the presence of rust-free trees in severely rust-decimated pine stands. We knew the life history and how to manipulate the rust fungus for resistant-testing purposes. What we needed was assistance in designing scientifically sound and genetically meaningful tests." The work began in the 1940's.

Anthony E. (Tony) Squillace, then a young Forest Service biometrist at the Intermountain Forest Experiment Station, was assigned to work with the resistance breeding team. The help of the Pacific Southwest Experiment Station's Institute of Forest Genetics in Placerville, Calif., was solicited, and Squillace and Bingham went there to be trained in controlled pollination. As a result of this association, J. W. (Jack) Duffield and Francis I. (Pete) Righter of the Institute began a long association with the Bingham-Squillace team. Later, James W. (Jim) Kimmey and Charles D. (Don) Leaphart, pathologists at the Intermountain Station, assisted procedures for artificial inoculation with the blister rust fungus. These well-designed and administered tests characterized the program.

During the 1950-57 period, the team made several hundred controlled pollinations between various pairs of phenotypically resistant white pines. Progeny tests of these first-generation offerings began with nursery sowings in 1952. As many as 30 to 35 percent of the first generation offspring and certain resistant parents survived artificial inoculation. Seedling survival was attributed to a number of foliar and bark resistant factors, the genetics of which remained obscure. However, genetic calculations indicated a potential increase in resistance of up to 50 percent with another generation of selection of resistance from first-generation trees. This ratio was considered sufficient for practical field planting

The scientists knew success was close at hand. In 1957 Squillace and Bingham came to the conclusion that they had managed to develop resistant trees. Occupying land on the campus of the University of Idaho, the tree genetics operations program was under way.

By 1968 the White Pine Genetics Project was administered by Raymond J. (Ray) Hoff and Geral I. McDonald. They had shown that second-generation progenies attained an average survival level of 66 percent. In addition, they had learned that the various foliar-and bark-resistant reactions were supported by a series of dominant, recessive and horizontal-type resistance genes that were being stockpiled by artificial selection. With this knowledge some 40 acres of seedling seed orchards were planned, where selected resistant first-generation seedlings would cross naturally to produce seed for planting stock. The seed orchards were composed of two-thirds resistant planting stock. Orchards were established near Coeur d'Alene between 1971 and 1974, and are slated to come into production about 1985.

Meanwhile, Hoff and McDonald are continuing work toward much broader based resistance, This work should meet the challenging need for a more resistant strain of western white pine in the future. It is, of course, realized that the blister rust fungus may change. If this happens, a second, much broader based seed orchard of naturally regenerated resistant stands, incorporating many more resistant genes, will be forthcoming. This should result in an ample stock of resistant planting seedlings to provide a supply of western white pine for future needs.

A somewhat similar but smaller rust-resistant project for sugar pine was begun in 1957 at Placerville, Calif. (now a PSW field station) and is well advanced.

Forest Service Region 6 conducts a large rust resistance breeding and testing program for western white and sugar pine at its Dorena Tree Improvement Center near Cottage Grove, Oreg., set up in 1966. The breeding arboretums for white pine are at Dorena, and those for sugar pine are at Grants Pass. Seed orchards are being expanded rapidly in all areas, and Regional nurseries will ship out over a million resistant seedlings, mostly western white pine, in the spring of 1981 for reforestation throughout the Region. Some *Ribes* reduction is still being done in critical areas.

EPILOGUE

Accomplishments of the Blister Rust Control Program

The *Ribes* Eradication Campaign

The following table summarizes briefly the progress made toward the protection of white pine by the eradication of *Ribes* from selected areas of white pine.

Acreage shown is that included within control units in 1959, at the peak of the program. These data show the magnitude of the *Ribes* eradication job rather than the amount of pine protected. A more meaningful measure of pine protected would have to be equated to the *Ribes* remaining in control units and within infecting range outside the units, and the amount of damage occurring to the pine. On this score, the work in eastern white pine rates high. Except for the northern section of the Lake States, *Ribes* was sparse, absent, or reduced to low levels and kept to low levels by crew work. Over most of the area the white pine of the East is no longer endangered by blister rust.

Protection of western white pines, however, fell short of expectations. Many *Ribes* remain in the pine forest types, both within control units and surrounding them. Pine infection is severe. There is, however, ample evidence that the rate at which pine is being damaged has been significantly retarded in the Inland Empire as a result of the many millions of *Ribes* removed from control units. Numerous stands of older reproduction and pole-sized white pine can be brought to harvest as a result of the control effort.

The damage situation in sugar pine forest varies greatly from North to South. It is severe in Oregon and northern California. Farther south it falls away sharply, regardless of the numbers of *Ribes* within or outside control units.

To compare results of *Ribes* eradication in the East with those in the West has no meaning other than to underscore the complexity of the western problem. No meaningful comparisons can be drawn because the blister rust problem in the two sections of the country differed greatly.

Pioneering in Forest Ecology

Early in the control program, Detwiler and others recognized that to remove permanently a native plant species from selected forest areas called for a thorough knowledge of that plant species and the circumstances under which it grew. They needed to know what manipulations to undertake in the forest ecosystem to accomplish permanent suppression of this species. Accordingly, *Ribes* ecology played an important role in the BRC program of both East and West, and much useful information on how best to suppress *Ribes* was derived from these studies.

Pioneering in Development Program

The development and testing of chemicals and equipment along with other studies of problems confronting rust control played a significant role in getting the program over rough spots. Use of chemicals that would eliminate *Ribes* at less cost than hand methods and the special equipment to destroy *Ribes* are two outstanding examples.

Contributions to Fire Control

Throughout the West blister rust control was an integral part of the fire protection program of the Forest Service and the fire protection associations. It was in fact looked upon as a first line of defense, and blister rust crews were called to fire duty regularly, year after year. It is difficult to estimate the acreage not burned or the timber not destroyed because blister rust forces were present. However, there is no doubt it was substantial. Large blister rust crews in strategic locations were well organized under competent leaders, had their own equipment and transport, and were ready to roll on short notice.

The BRC program paid a heavy price for its role in fire control. Although fire funds paid salaries and wages of blister rust crews while they were on fire duty, the program could not be compensated for disruptions and time lost in *Ribes* eradication. Blister rust camps operated for a short season, and substantial investments in camp establishment and operation constituted a major portion in *Ribes*

Summary of *Ribes* Eradication Work in the United States as of 1959

	Eastern White Pine	Western White Pine	Sugar Pine	Total
Acres in control	20,945,741	1,149,620	912,551	23,007,915
Acres worked once	20,248,313	874,670	704,388	21,827,371
Acres worked two or more times	2,466,032	450,020	419,059	3,335,111
Acres on maintenance	17,802,281	424,650	285,320	18,512,251
Amount in dollars expended on *Ribes* eradication	38,632,855	36,483,092	24,962,623	100,078,570

"On maintenance" represents areas on which *Ribes* populations have become stabilized at control-standard levels and will remain at those low levels until the area is disturbed by logging, fire, or other activities. Data are from Division of Pest Control, Forest Service, U.S. Department of Agriculture.

eradication costs. Time lost due to fire made it necessary to spread this expense over a reduced number of days that crews could work on *Ribes* eradication. Along with this direct interference were indirect losses arising from fatigue due to firefighting and in increased turnover of the labor force. It was estimated at one time nonreimbursable losses due to fire duty increased BRC costs by one-third.

Assisting Students and Others

Thousands of young men were employed on the blister rust program. Many came back for several consecutive years. A substantial number became interested in forestry as a result of their experience in blister rust. The ranks of the Forest Service and other conservation agencies are liberally sprinkled with men, some in high places, whose introduction to forestry took place in a *Ribes* eradication crew.

BRC has been called "the spring board for a forestry career." Men who did a turn at "the *Ribes*" can be found in Congress, State legislatures, foresty schools, executive offices of timber companies, State governors' offices, and the executive office of the President. The BRC's stimulation of interest in forestry and forest conservation certainly was one of its most significant contributions.

During the NIRA–WPA emergency days, thousands of unemployed men, many down on their luck, received a new lease on life as a result of regular hours of healthful work in the outdoors and well-balanced, wholesome meals.

Awareness of the Importance of Pest Control

Before the blister rust program, most American foresters gave little thought to forest diseases and insects. When they thought of forest protection, they thought solely in terms of protecting forests from fire. Blister rust changed that. All forestry organizations have become fully aware of forest pest problems and the need to deal with them in an organized manner if the practice of forestry is to be successful. All units of the Forest Service and most States now have a corps of disease and insect specialists working closely with other management groups in the field of forestry.

The Men Who Ran the Blister Rust Program

The men running blister rust control were a tough breed of woodsmen who worked hard, long hours at a pioneering job fraught with numerous unknowns and pitfalls. They were a young bunch, full of energy, with the will to tackle all obstacles and a reluctance to take no for an answer.

Perhaps their character is summed up best in a report made by a team of investigators instructed by the Agriculture Appropriations Committee of the U.S. Congress in 1943 to evaluate the BRC activity. Blister rust leaders were instructed by the Secretary of Agriculture to give their full cooperation to the investigating team, arrange interviews with all persons they wished to contact, open all records, answer all questions, provide transportation for them, and escort them to centers of field work and wherever else they wished to go.

The investigators spent a year at their task. They interrogated all blister rust regional leaders, examined in detail all office field records, contacted and discussed the work with many cooperators, and reviewed field work by discussing various aspects of the program with field leaders, foremen, and laborers. Their report, generally favorable, had this to say about the men who ran the program:

> The blister rust leaders are a dedicated group completely committed to the pursuit of their assigned tasks to the best of their ability. They work hard and long hours. They know what they are about. They are well regarded by cooperators and the people who work for them. Throughout our investigations we turned up no evidence of malfeasance or wrongdoing. Mistakes made, and there were some, were errors of judgment. People interviewed spoke highly of the program and of the people conducting it.

This commentary is a good note on which to end the narrative of the fight to control blister rust. Let this be the epitaph of those hardy men who conducted the program: *You fought a good fight.*

The Future of the White Pines

For eastern white pine the picture is clear. Over most of its range there is no longer a serious problem. Blister rust can be dealt with as a secondary pest.

In the sugar pine forest types, rust damage is severe in Oregon and northern California and in local spots in the Sierras. But in much of the Sierras, extensive areas show little or no rust damage because the environment is unfavorable to its spread and development. The picture is less clear for the white pine species that occur at high elevation in the Rocky Mountains and Sierra Nevadas: Limber, bristlecone, whitebark, and foxtail pines. Present indications are that, at least in the southern parts of the range of these species, rust action will be minimal.

Western white pine in most of its range, and the sugar pine of Oregon and northern California, face the most critical future, for it is within these forest areas that the rust is proving most devastating. But even here there is reason for optimism in the long run.

The genetics programs should, before long, turn out large quantities of rust-resistant planting stock. Also, natural resistance will come to the rescue of the white pines. Over the years the more susceptible pine trees and their progeny will succumb to the disease, and more resistant ones will replace them. As time goes on, the resistance factor will increase, for this is the way a plant species adjusts to a new disease—by natural selection.

Nearly all American chestnut trees, unfortunately, proved to be equally susceptible to that blight. So, too few chestnut trees survived to develop resistance, either artificially or naturally. But the white pines do have a built-in resistance factor that can be enlarged upon. Evidence in the Lake States and in the Pacific Northwest shows that blister rust is already becoming less virulent and that natural resistance is slowing the amount and rate of pine damage. In the long look ahead, the white pines of America will adjust to the exotic blister rust fungus, helped along by human efforts.

APPENDIX I: Selected Bibliography

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APPENDIX II: Persons Interviewed

Washington, D.C.: Gilbert B. Posey, onetime right-hand man to Samuel Detwiler, was the last living member of the original blister rust control staff in Washington, D.C. He died in Washington April 22, 1980.

Northeastern Region: Edmund Filler, longtime Leader of the Northeastern BRC Region; Moston R. Mulholland, former State and Area Leader in the Northeast and last Leader of the Northeastern BRC Program; Martin Calderarra, former District Leader in Maine; Steve Bomer, former District Leader in New Hampshire; Nobel Harpp, former District Leader in New York; and Fred Siever, former State Leader in New York.

North-central Region: Henry N. Putman, former Leader of the North-central BRC Region, and early Office of Blister Rust Control scout in the West; Glenn Allison, former State Leader in Michigan, Area Leader, Leader of the Northeastern BRC Region, and finally Assistant Eastern Regional Forester in charge of State and Private Forestry in USDA Forest Service Region 7; Spar Sager, former District Leader in Michigan; Ray Weber, former District Leader in Wisconsin; Ted Kouba, former State Leader in Wisconsin; Jake Licke, former District Leader in Minnesota, and Lawrence Ritter, former State Leader in Minnesota.

Southern Appalachian Region: J. Curtis Ball, former Regional Leader in southern Appalachians, District Leader in Minnesota, and crew foreman in California.

Pacific Coast Region: Thomas H. Harris, former Regional Leader; Roy Blomstrom, former Regional Leader; Conrad P. Wessela, former Head of BRC in Oregon and Chief of Pest Control, Region 6, USDA Forest Service, Portland, and Assistant Director of Forest Pest Control, Forest Service, Washington, D.C., in charge of Disease Control Program; Harold R. Offord, former Head of the methods development and improvement unit of BRC, and Chief of Forest Disease Research of Forest Service's Pacific Southwest (PSW) Forest Experiment Station, Berkeley, Calif.; Douglas R. Miller, former field supervisor of BRC in California, and of forest patholologists in Region 5, Forest Service, San Francisco, and at PSW Station, Berkeley, Calif.; S. Daryl Adam, former BRC field supervisor in California, and assistant Area Leader in the North-central Region, BRC, and Benton Howard, former field supervisor in California, and Chief of Pest Control in Region 6, Forest Service, Portland.

Northern Rocky Mountain Region (Inland Empire): Roger Billing, former Chief of Timber Management on Kaniksu National Forest; Harry Faulkner, former field supervisor of BRC in the Inland Empire; Lee White, former member of staff in charge of BRC on Kaniksu National Forest; Dave Kyle, former BRC field supervisor on Clearwater National Forest; Harold Brichle, former BRC field supervisor on Kaniksu National Forest; Clyde J. Miller, former BRC field supervisor on St. Joe National Forest; Sydney Skogland, former operations supervisor in Montana; Virgil D. Moss, former methods development and improvement project scientist in the Inland Empire; Homer J. Hartman, former head of BRC on St. Joe National Forest, and head of BRC and Pest Control for Region 1, Forest Service, Missoula, Mont.; Charles R. Wellner, former silviculturist at Forest Service's Northern Rocky Mountain Forest Experiment Station, Missoula, white pine mangement expert, and an associate with BRC in Inland Empire, and Royce Cox, chief forester for Potlatch Forests of Idaho.

Others: Dr. George Hepting, former principal forest pathologist in the Division of Forest Pathology, Southeastern Forest Experiment Station (USDA Forest Service, Asheville, N.C.), and Dr. Thomas Buchanan, forest pathologist and former Assistant Director, Division of Forest Pathology, Southeastern Forest Experiment Station, Forest Service, Asheville, N.C.

APPENDIX III: Personnel and Administration 1933–67

In 1933 the USDA Bureau of Entomology and Plant Quarantine (or "EPQ" as it became known by many) became responsible for the quarantine functions of the old Horticultural Board (which was abolished), the entomological (insect pest) work of the former Bureau of Entomology, and the blister rust work and control of the stem rust of grain from the Bureau of Plant Industry (BPI). Blister rust was removed from BPI because quarantine functions, both foreign and domestic, were required, and because BPI was not geared to handle a program of the magnitude of blister rust. The Office of Blister Rust Control in BPI had long been headed by Samuel B. Detwiler.

Lee Strong, a quarantine man, was brought in from the California Department of Agriculture to head EPQ. He had a reputation as a good organizer and a no-nonsense administrator. Detwiler transferred to the USDA Soil Conservation Service. His assistant, Gilbert B. Posey, joined him there within 2 years. Stephen N. Wyckoff, head of the Western Blister Rust Control Office in Spokane, Wash., transferred to the USDA Forest Service. And I, then an assistant to Wyckoff, handling the BRC work in California, also requested permission to do so.

Strong sent his deputy, Avery Hoyt, to California to urge me to remain with EPQ by agreeing to remove BRC work in Oregon and California from the jurisdiction of the Western BRC Office at Spokane, and give it independent and equivalent status. So I remained with EPQ.

A former State plant quarantine man also became Director of the USDA Division of Plant Disease Control, set up to house the blister rust and barberry eradication programs in EPQ (barberry being the alternate host for the rust of small grains). He was Dr. S.B. Fracker of the Wisconsin Department of Agriculture. Dr. James Martin, who had done a splendid job of running the Eastern Blister Rust Control Program under Detwiler, was second in command. Dr. Lee Popham, an experienced barberry eradication man from the Midwest, was brought in as the other assistant to Fracker. Within a few years, Popham was promoted to assistant chief of EPQ and placed in charge of all disease and insect work for that Bureau. L.

Kenneth Wright, another barberry eradication man, came in from Pennsylvania to replace Popham as Fracker's assistant.

Fracker was in charge during the emergency relief program years 1933–1944, when blister rust control was big business. In 1945 Strong shifted Fracker to the Domestic Plant Quarantine Division of EPQ and promoted Martin to the director's spot. Martin remained head of the Blister Rust Control Program until 1954, carrying forward the basics of the program in which he and Gilbert Posey had played leading parts during the Detwiler administration.

In the fall of 1953 responsibility for the Blister Rust Control Program was shifted again, from the Bureau of Entomology and Plant Quarantine to the Forest Service. This shift came about largely because blister rust was becoming recognized as primarily a forestry problem, one intimately related to silvicultural treatment and management of white pine forest types. Blister rust control remained for so long in bureaus other than the Forest Service because of the manner in which plant pest problems were handled by USDA in the early years. Cooperative relationships were needed with plant regulatory agencies of the States, and both foreign and domestic plant quarantines played an important role during the first decades of the program.

By 1954 blister rust had spread to most white pine forest types in America, and plant quarantines had ceased to be important. The problem was now one of integrating blister rust work into forestry.

In 1953 I entered the Washington scene. When blister rust control was transferred to the Forest Service, I was serving as regional director in charge of several EPQ programs for the Western States. Avery Hoyt, then chief of the Bureau (succeeding Lee Strong and P.N. Annand who had died a few years earlier), was my boss. He called me to Washington for reassignment.

While in Washington I was asked by the Forest Service to consider a transfer to run the Blister Rust Control Program for them. Inasmuch as EPQ was bereft of all forestry work following the reorganization, and I was a forester, I accepted the Forest Service offer with the consent of EPQ.

Dr. Martin, although close to retirement, agreed to transfer to the Forest Service and remain for a year to assist me. Within the year Martin retired, and Conrad Wessela, one of the mainstays in western blister rust control work, was called to Washington as assistant director. Blister rust control was set up as a division in the Washington Office of the Forest Service in November 1953. That division was abolished in April 1956 and its functions were transferred to the newly created Division of Forest Pest Control, which had reponsibilities for disease control, including blister rust and all insect control work. I was named director, and Wessela became my assistant in charge of forest diseases.

A major task was integrating blister rust control into the Forest Service organization. The shift presented some problems for BRC personnel. Under EPQ blister rust control was the only job of field personnel. At all levels—from regional leader to operation supervisor to unit supervisor, or from State leader to district leader—the personnel remained at their assigned locations and tasks year after year. Within the Forest Service, however, blister rust was but one more activity among many for headquarters and field people. Also, Service personnel were subject to frequent reassignment to other geographic areas at the field office level, and various forestry jobs were often handled on a priority schedule based on available funding and the expertise of the forest supervisor and ranger. BRC, as a new program which was usually not fully understood, was often placed low on the work list. This was especially true at the ranger district level, and foresters needed several years to develop interest in the job.

Some BRC people adjusted to the new arrangement; others did not. The merger was not without its people problems. However, the shift went smoothly for the most part. The Forest Service leaned over backwards to accommodate its new arrivals, and the marriage turned out to be a good one.

During this period of administration, forest pest control work, including blister rust, was accepted by all National Forest regions as an essential part of forest management. Each regional headquarters had a forest pest control unit. In some, this unit was located under the timber mangement program. In others, it was located in the State and Private Forestry progam.

At the time Wessela and I retired in December 1966, forest pest control was fully integrated into its Forest Service home. Likewise, other Federal land managing agencies and most State forestry organizations had pest control units to deal with forest diseases and insects. The management of forest lands to minimize damage caused by potentially destructive diseases and insects and the suppression of threatening outbreaks had come of age and won its rightful place as a essential forestry activity.

During the mid-'60's the Blister Rust Control Program began to wind down. Shortly before my administration ended, the Forest Service conducted a major reevaluation, and efforts to control blister rust in many of the western pine areas, and in portions of the Lake States where it was still serious, were terminated because of excessive costs in relation to benefits. In the eastern white pine range, *Ribes* eradication work had accomplished its purpose; blister rust had become only a secondary pest in most areas. The big job was done. The cultivated black currant had been eliminated. Wild *Ribes* species on millions of acres had been suppressed to such low levels that they were no longer a problem. With so few *Ribes* remaining, pine infection fell off to a trickle.

While some blister rust control activity continues to this day in some white pine areas, it is no longer handled as a special program. Instead, as with other forest disease problems, it is dealt with on a year-to-year basis in much the same manner as native diseases, with funding from regular forest insect and disease appropriations. The heyday of blister rust control is past.

Appendix IV: Reasons for the Lea Act

The reasons cited as to why the blister rust bill was introduced in Congress and recommended for passage were contained in a letter dated March 15, 1939, addressed to Honorable E. D. Smith, U.S. Senate, from Henry A. Wallace, Secretary of Agriculture. This letter appears in

the Legislative Report of the Senate Committee on Agriculture and Forestry that accompanied the bill when it was reported out. The following is quoted from Secretary Wallace's communication:

The experience of the Department with this disease during the past 20 years has led to the inescapable conclusion that, if our future forests of white and sugar pine are to be maintained, a unified and coordinated control program must be systematically carried out on large areas of white pine forest lands, irrespective of ownership lines. At present this need is particularly acute in the mountainous areas of the Rocky Mountain and Pacific Coast regions because (1) forest lands often consist of a mixture of Government, State, and private holdings intermingled within the same topographic units; (2) blister rust spreads from currant and gooseberry plants *(Ribes)* to the pines without regard to political or ownership boundaries so that these plants on one tract can result in the complete loss of the trees on lands in other ownerships or managed by other agencies; (3) no single owner whether public or private, by control operations solely on his own property, can protect himself against invasion of the disease; (4) shifts in interest and ownership of lands are inevitable because of the time interval required to grow a forest crop. These reasons, together with the need for protecting the forests of the future, and stabilizing the supplies of these valuable timber trees, necessitates the systematic application of control measures regardless of ownership.

The blister rust control program is one of great public importance and is of vital interest to the Federal Government not only from the fact that it is the largest single owner of white pine forest lands but also because the white pines, which are highly susceptible to attack, constitute a key resource and the basis on which a wide range of communities and commercial enterprises obtain their economic support. Everything possible should be done to insure perpetuation of these essential forest trees; and legislation which would authorize the carrying out of a unified control program, assuring the protection of this natural resource during periods of harvest and growth, would aid in the protection of vast interests of public concern as well as public property from preventable losses from a disease which recognizes no artificial boundaries.

This legislation is known as the Lea Act (Public Law No. 486–54, Stat. 168, 169) approved April 26, 1940. It applies only to white pine blister rust and reads as follows:

For forest protection against the white pine blister rust, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress Assembled, That to promote the stability of white pine forest-using industries, employment, and communities through the continuous supply of white and sugar pine timber, the Secretary of Agriculture is authorized in cooperation with such agencies as he may deem necessary to use such funds as have been, or may hereafter be, made available for the purpose of controlling white pine blister rust, by preventing the spread to, and eliminating white pine blister rust from all forest lands, irrespective of the ownership thereof, when in the judgment of the Secretary of Agriculture the use of such funds on such lands is necessary in the control of the white pine blister rust: *Provided,* That in the discretion of the Secretary of Agriculture no expenditures from funds provided under this authorization shall be made on private or State lands (except where such lands are intermingled with those which are federally owned and it is necessary in order to protect the property of the United States to work on those parts of the private or State-owned lands that immediately adjoin Federal lands) until a sum, or sums, at least equal to such expenditures shall have been appropriated, subscribed, or contributed by State, county, or local authorities, or by individuals or organizations concerned: *Provided further,* That no part of such appropriations shall be used to pay the cost of value of property injured or destroyed: *And provided further,* That any plan for the control and elimination of white pine blister rust on lands owned by the United States or retained under the restriction of the United States for Indian tribes, and for individual Indians, shall be subject to the approval of the Federal agency or Indian tribe having jurisdiction over such lands, and the Secretary of Agriculture may, in his discretion, and out of any moneys made available under this act, make allocations to said Federal agencies in such amounts as he may deem necessary for white pine blister rust control and elimination on lands so held or owned by the United States, the moneys so allotted to be expended by said agencies for the purposes specified.

NOTE: The mention of trade, firm, or corporation names in this publication is done solely to provide the reader with a historically accurate account of the blister rust control program. No endorsement by the U.S. Department of Agriculture of any product or service to the exclusion of others equally suitable is intended and should not be implied.